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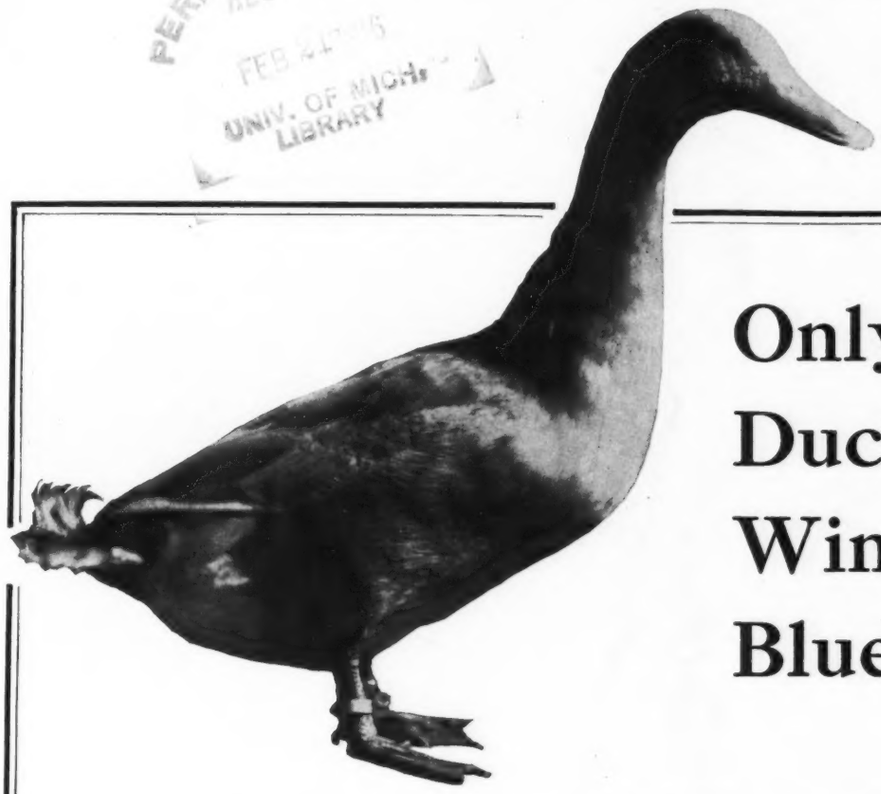

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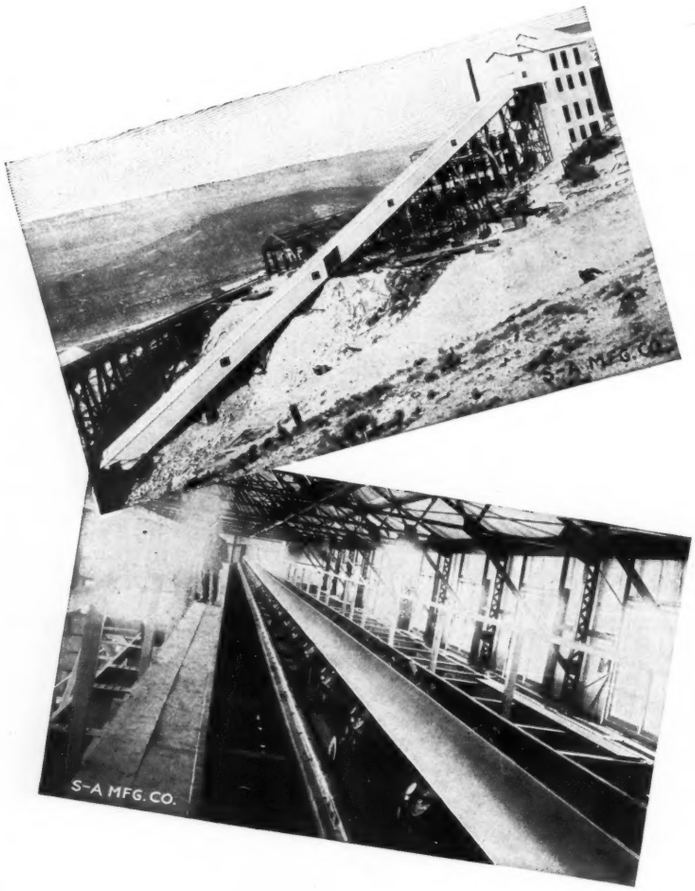

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Engineering and Mining Journal

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The Gold Lake District, Manitoba, Canada

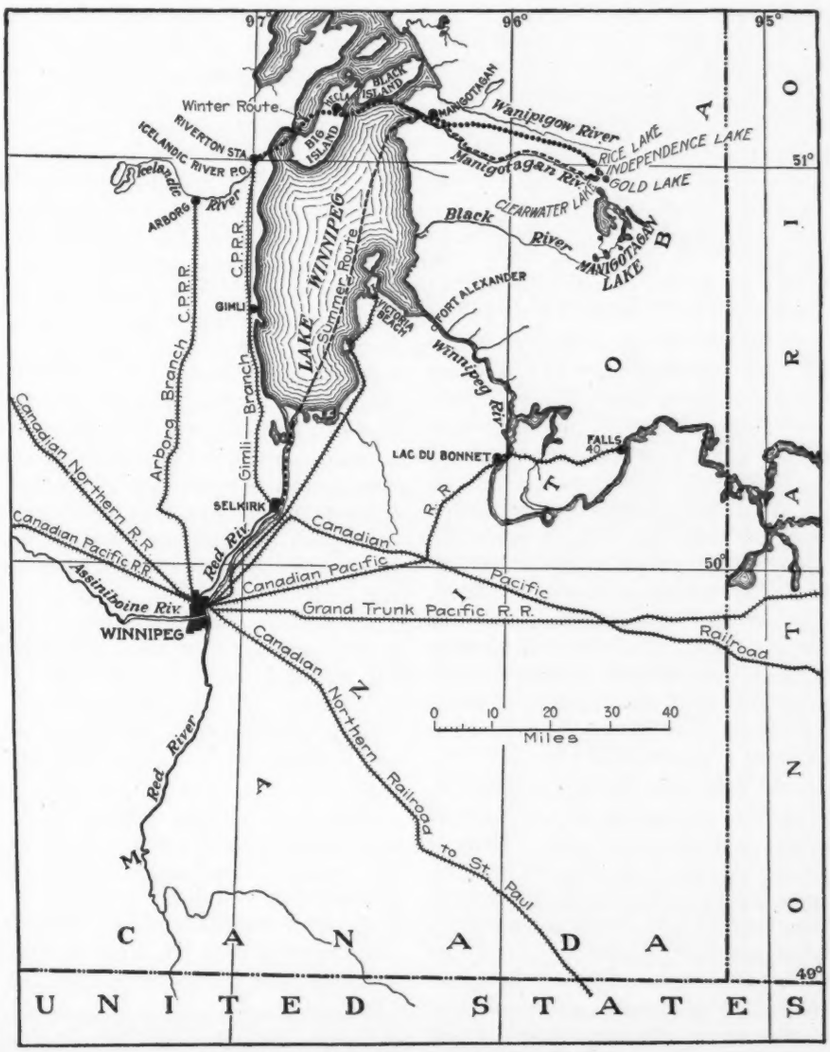
By George A. Packard*

SYNOPSIS—A district in which some recent sensational gold discoveries were made at the grass roots. Sulphides come in at shallow depth. There is no certainty of commercial deposits in the district, but development is being pushed.

The Gold Lake district is situated about 100 mi. in an air line northeasterly from Winnipeg. Claims in the district are shown on the map of "Claims in the Big Rice Lake District," issued by the Canadian Department of Mines, and it is probably officially a part of the latter district. The situation and the routes from Winnipeg are shown on the accompanying map. In the winter, with good weather, the trip requires two days from Riverton with a sleigh, there being a good winter road cut through. There is also a trail from Fort Alexander available for dog sleds. In summer a boat may occasionally be found going direct to Manigotagan, or Lake Winnipeg may be crossed by motor boat from Riverton or from Big Island, the latter point being reached from Selkirk by steamboat twice a week. From Manigotagan it takes a day and a half of good paddling, there being no summer road as yet.

The topography is rough, but of low relief, probably no hills rising over 100 ft. above the neighboring water level and muskeg; there is much of the latter, perhaps one-quarter of the country. Though it may not be true bottomless muskeg, it makes traveling difficult. The elevation is about 900 ft. above sea level. Poplar, jackpine and spruce abound, though but a small portion is large enough for saw-timber.

The general geology of this region has been described by J. B. Tyrrell (Geological Survey of Canada, Annual Report, Vol. XI, 1898, Part G) and by Elwood S. Moore (Canadian Geological Survey, Department of Mines, Summary Report for 1912). Doctor Moore's map shows a central band termed the Wanipigow series, extending southeasterly for over 50 mi. from the Hole River Lake. This is made up of conglomerate, graywacke and accompanying rocks. On either side is a band assigned to the Keewatin, including greenstone quartz and porphyry, rhyolite, trachyte, felsite and schists. These bands are each apparently from 3 to 8 mi. wide, and north and south of the aggregate the entire country



MAP OF GOLD LAKE MINING DISTRICT

*Mining engineer and metallurgist, Boston, Mass.

is indicated as granitic. All are assigned to the Pre-Cambrian. Prof. R. C. Wallace has discussed the geology of the veins at Rice Lake ("The Rice Lake Gold District of Manitoba," Canadian Mining Institute, XVI, 1913). He says the quartz veins there as a rule lie in a feldspar porphyry, which is the dominant rock in the Keewatin in this area and which, even in its altered condition, is remarkably poor in quartz and was originally a plagioclase feldspar rock probably to be classified among the trachytes.

The Gold Lake district is about 3 mi. southeasterly from Rice Lake. The first discovery there was made early in 1914, but no work was done until the past summer. The country rock here is a much metamorphosed quartz-feldspar porphyry. The examination of a typical thin section showed a ground mass of quartz, orthoclase and abundant biotite, with a little chlorite, epidote and magnetite. This rock extends northwesterly and is apparently a continuation of that at Rice Lake. The feldspar crystals are much elongated by compression, and the rock itself has developed a schistose structure along several shear zones, having a general northwesterly and southeasterly direction. A possible cause of this compression is suggested by the presence to the east of a granitic rock which, at the two or three points where I saw it, appears to be more recent than the porphyry. This shows plagioclase, biotite and hornblende, and might perhaps be classified as a granodiorite or quartz diorite. The presence of this granite is not indicated on Doctor Moore's map, from which it may be inferred that it is of limited extent, although I am confident that it extends in a northerly and southerly direction for at least a mile. A thin section from a specimen of considerably altered granite on the westerly side of the porhyry, near Clear Water Lake, shows alteration products which may have resulted from the same minerals, and that granite may belong to the same magma.

Veins Are in Shear Zones with Little Faulting

The principal veins accompany the shear zones. These are very persistent, and some of them may be traced for a mile or more in a nearly straight line. There is little faulting. The quartz is up to 10 ft. in width and sometimes is scattered for much greater widths through the schists, which are frequently highly silicified. In some of the veins there are included angular pieces of the silicified porphyry, though not in all. This is especially noticeable in one vein where there is considerable torsional shearing. The quartz is often white and coarse, or glassy, the typical "bull quartz" of the Western prospector; but in other places it is nearly black. There is considerable pyrite and occasional chalcopyrite and bornite. Only rarely has blende or galena been seen in this district, though to the north of Hole River it is said that there is considerable zinc and lead to be found.

The first discoveries of gold were rather sensational, the metal appearing on the rusty outcrop in frequent nuggets up to one-quarter inch or more in size. There is perhaps considerable concentration here, but at a depth of 2 ft. the oxidized zone gives place to sulphide ore with bornite, the concentrates from which, after amalgamation, carried high gold. Another vein shows fine gold disseminated across a width of 6 to 8 ft. There is no silver of commercial importance. The outcrops are covered to some extent with soil and muskeg, but the moss and brush have been largely burned off by recent fires. The dip of the veins appears to be nearly vertical. Near the granite they are much more irregular in strike and less continuous, with some cross and branching fissures. Some veins are said to have been found in the granite, but all the quartz that I saw there appeared to be merely local segregations.

At the time of my visit in October, there was no development to demonstrate whether or not pay ore occurs in commercial quantity. The deepest shaft in the district, down less than 20 ft., showed considerable heavy gold in primary ore. At the present time I understand that two or three properties are being developed as rapidly as possible under the conditions that exist.

Railway Traveling in Mexico*

On the day on which we later learned the State Department at Washington had issued a statement of the "revival of business" and "return to regular operation of the railroads in Mexico," we left Piedras Negras for the south. Carranza's special train left Piedras Negras two days before, late in the forenoon, instead of at sunrise as planned.

Our party, which included John R. Silliman, the American representative with Carranza, had planned on leaving by the "regular" train the following morning, also at sunrise. It did not go at that hour, nor at noon, nor at sunset, and a disheartened band of Americans returned to the hotel for another night, or part of a night, first obtaining the solemn assurance of the *jefe de estacion* that they would be able to obtain in the morning the seats which they had bought, but playing safe by employing half a dozen *mozos* to wait at the station until the train was made up and then to climb in and occupy the seats until their patrons arrived.

Even this did not satisfy one member of the party, whom subsequent events proved to be right, and it was discouragingly soon after midnight that the whole party was routed out and driven to the station. The train was there, but not open. Around the filthy station—wherever Mexican soldiers have been there is filth in plenty—were scores of prospective passengers, blanketed and lying wherever there was room to lie, waiting for the train. One of the government's railroad employees proved willing to be corrupted, the cars were opened, and with a rush something over 500 passengers charged into accommodations for 150.

At first we recognized only that there were no lights in any cars, save for the light of 500 cigarettes. As the hot sun of November in the *tierra caliente* rose, we were to discover that likewise there were no windows, which, after all, proved to be all that saved us from suffocation and the absorption of a few million germs from our neighbors.

Also there was no upholstery, the soldiers having cut away every inch of plush to make saddle cloths or dresses for the *soldaderas* who accompany the "armies." It is uncomfortable to sit on exposed springs. Some of the seats were gone altogether, which made it possible for more passengers to jam themselves into the space the seats had occupied. Window shades had disappeared. Even

*Slightly condensed from an article, by Mark S. Watson, that was published originally in the New York "Sun" and Chicago "Tribune," and copyrighted by those journals, to whose courtesy we owe permission to use it here.

the bell cord was gone, and there was speculation as to how the engineer could be ordered to stop in case of trouble toward the rear.

There came a wail from outside the car from a belated American who could not force his way to the car platform, much less into the car. Again the absence of windows proved a blessing, for we hauled him through and seated him on the stack of baggage in the aisle.

Some Asleep on the Rails

Then the trainmen started their rounds, waking the passengers who had continued sleeping, most of them under the cars, their heads on the rails. Exactly why the peon prefers to sleep with his head on a rail is one of a million mysteries about the peon, but it is said that most of the deaths on the Mexican railroad rights-of-way are due to this predilection. Hence a moderately human engineer will send his crew along a standing train to drag the slumberers out of the way before switching begins.

The fiction about the start at 4 a.m. was exposed. It was 8 before the engineer tested the air, and it was after 9 when the train moved slowly away, stopping every few hundred yards for no discernible reason except to train the Americans to be patient.

A couple of Mexicans mounted on burros rode past us on the near-by highway. We overtook them two or three times, but during an extra-long delay they disappeared far ahead and we never caught up. This is on the road which at one time could compare favorably with any American railway. Also it is the road on which, according to the State Department, regular service had been resumed.

A train of soldiers ran just ahead of us, we supposed, as an escort to ward off bandits. It left us eventually, and we found we had not been thus watched over, the motive being simply the transportation of the patriots who had tired of Piedras Negras, for which, to be quite fair, they were not to be blamed. We stopped on the slightest provocation, and before the train was at a standstill it was surrounded by dirty men and dirtier women and dirtiest children, who had appeared from a supposedly blank landscape, each carrying water or coffee or bread, cakes, candies, sugar cane, cigarros, or anything else to lure the passengers. Appetite failed the Americans, but never the Mexicans, who bought liberally and sometimes paid.

It was considered a clever jest to barter with the sellers beneath the window until the train pulled out and then refuse to pay anything. The profanity which then would rise quite eclipsed anything which Billingsgate on its busiest day can show.

Hard by the station at Piedras Negras had been noticed a disabled engine so far gone that the Mexican officials had despaired of reviving it. Later we were to remember it as a harbinger of the industrial tragedies to be seen further south. Perhaps nothing else in all miserable Mexico is more tragic than the shocking vandalism which has ruined the once splendid railways.

Roads Are Wantonly Ruined

It is safe to say that we did not pass a single mile of track without seeing evidence of the manner in which the revolutionists of every faction have wantonly destroyed the very arteries of the country—railroad communication. On either side of the track lay the burned and twisted remnants of what once had been fine freight cars, many of them, incidentally, owned by American roads.

Occasionally there appeared whole trains that had been burned on the tracks or first wrecked, looted and burned. Huge locomotives had been rolled over and stripped of vital parts. In all that whole stretch there was not one bridge which had escaped dynamite. The telegraph wires had been severed and many poles cut down, sometimes for fuel, sometimes from mere wantonness.

The roadbed has not seen a pick or shovel in the long years of revolution, and the fact that it continues as good as it is can be only evidence of the splendid construction work done by American builders and American dollars in the days of Don Porfirio Diaz. Over this neglected roadbed, past wrecks that we soon quit counting, in dilapidated equipment with more visible neighbors than we wished and only an unpleasant hazard as to the number of invisible companions concealed in the dirty *serapes* the wheezing locomotive dragged.

Evidence of the Torch

We would reach a settlement where in the old days had stood a neat station and freight shed, a few section houses, a water tank and the adobe houses of the village. With regularity the station had been gutted by fire and the wood built sheds consumed completely. Generally the water tanks had been blown up, and if they had not been wrenched apart, had been reset on temporary bases—temporary, as there was no good way of telling there would not be another revolution based on equally high principles which would bring further wanton destruction of national property which the revolutionists, if successful, would themselves have to rebuild out of a looted and bankrupt treasury.

Theoretically, it has been a revolution against wealth and privilege. Under Mexican reasoning, maybe that furnishes justification for the wanton looting of the fine big *haciendas*, although it did not matter whether or not the *haciendado* had ever taken any part in politics; but it is difficult to grasp the idea under which the miserable little hovels of the poor should also be burned to ashes. That is another of the million mysteries.

We were supposed to reach Saltillo late in the evening. We did not. We finally passed Carranza at Hermanos, where he had tarried, why no one knew, to remain two or three or maybe six days. *Quien sabe?* It was evening when we reached Monclova, less than half our run, and here was another delay, carefully concealed in advance, so that no one might have a chance to scour the town in search of moderately clean food. The run continued, now at better speed, and the Americans detailed night watches so that most could sleep while one remained awake to watch the baggage and prevent its being carried off bodily by the Mexicans, whose aptitude for petty thievery is beyond the realm of competition.

Engine Off the Tracks

It was just past midnight when the watch loosened a yell and the sleepers waked just in time to be thrown in a heap against the forward seats. Most of the Mexicans remained sleeping in their seats, between the seats or in the aisles, unconcerned over the possibility of having their faces walked over. Scouts crawled out the windows and ran forward, there to find the engine and two cars off the track. Why it had not happened as the train was crossing a gully only a singularly watchful Providence,

which must be engaged 23 hours a day at least in watching over Mexico, can say; but it was our luck to have it happen on a level stretch.

It developed that a switch had been missed—in part owing to the merry habit of running without headlights, in part to a faulty locking device. Did the crew set about repairs of any sort? Far from it. The engineer's first act was to dump the fire. His next was to find his blanket and move off among the cactus and rattlesnakes to sleep, in which he was assisted by the fireman.

No one went ahead for help. No one thought of tapping the telegraph wire, if it was alive. No one thought of sending a flagman back to signal any following train. The Mexican mind simply decided that sleep was *de rigueur,* and the passengers had their choice of sleeping in the unprotected train or among the reptiles of the desert or staying awake.

Another day dawned for those who had never before seen three successive dawns. The fog lifted, and a few miles away rose majestic peaks, some rounded, some serrated, some in the curious volcanic cone so often seen in Mexico.

The Engineer's Nap Disturbed

A troop train came, and the engineer was persuaded to pay some attention. He left his cars on a siding, threw off a cord or two of ties, theoretically for wreck repairs, coupled to the rear cars of our train, pulled them back, and then again slammed them together with a bang.

That accomplished, there was further consultation, and finally the rescue party calmly hooked up once more and proceeded away in the other direction. It was afternoon and frightfully hot, when there came another locomotive, which again uncoupled our cars, took them in tow, and with the wrecked equipment lying there on the main track undisturbed, away went the surviving cars. No damage had been done save to disturb the engineer's nap and the merely mentionable fact that another locomotive had gone out of commission.

It was late that night when we finally reached Saltillo, a distance of less than 450 kilometers, or some 280 mi. It had taken over 40 hr. This road, according to the State Department, was running regular service. It was. Regularly miserable.

Department of Interior Issues Bulletin on Alaska

It is not generally realized that if Alaska were superimposed upon the United States the southeastern point would be in the vicinity of Charleston, S. C., and the southwestern point in the vicinity of Los Angeles, Calif. The northern point of Alaska would come to the Canadian boundary and the southern border of the main portion would reach the northern boundary of Oklahoma. The enormous size of Alaska is strikingly brought out by a small map contained in the pamphlet entitled "General Information Regarding the Territory of Alaska," just issued by the Department of the Interior, at the direction of Secretary Lane. This pamphlet, which should be in the hands of every person contemplating settling in Alaska, contains detailed information regarding the geography, climate, population, government, commerce, resources and transportation facilities of the territory.

An interesting feature of the publication is a table showing the hours of daylight at different latitudes for the first day of each month, so that the tourist contemplating a vacation trip to this land of the Midnight Sun can easily determine the localities at which daylight is continuous. The pamphlet contains also information regarding tourists' trips, a list of steamship companies operating between Seattle and Alaska, rates of fare and approximate time from Seattle, lists of telegraph and radio stations and post offices and a directory of all Government officers stationed in Alaska.

Canadian Mining Institute

Notice is given that the eighteenth annual meeting of the institute will be held in the City of Ottawa on Wednesday, Thursday and Friday, Mar. 1, 2 and 3, 1916.

The institute's headquarters will be the Chateau Laurier. Several amendments to the bylaws are to be submitted.

The following nominations for office have been submitted: For president, Arthur A. Cole, Cobalt, Ont.; vice-president, Charles Fergie, Montreal, and T. W. Gibson, Toronto; councillors—for Alberta, R. H. Morris, Pocahontas, and Lewis Stockett, Calgary; for British Columbia, Thomas Graham, Victoria, Gomer P. Jones, Hedley, and M. E. Purcell, Rossland; for Ontario, Norman R. Fisher, Cobalt, A. D. Miles, Copper Cliff, W. E. Segsworth and Clifford E. Smith, Toronto; for Quebec, John A. Dresser, Montreal.

Among others the following papers will be presented for discussion:

"Flotation Processes," by T. A. Rickard.
"Flotation at the Anaconda Mines," by E. P. Mathewson.
"The Concentration of Molybdenite as Applied to Canadian Ores," by Henry E. Wood.
"The Flotation of Bornite," by H. W. DuBois.
"Some Effects of the War on the Mining and Metallurgical Industries of Canada," by A. Stansfield.
"Canadian Supplies of Iron and Steel in Relation to Munitions of War," by Thomas Cantley.
"The Coal Resources of Canada with Special Reference to the Metallurgical Industries," by J. B. Porter.
"The Coal Situation in Canada," by W. J. Dick.
"The Magnesite Industry in Canada," by Howells Frechette.
"Discovery of Phosphate of Lime in the Rocky Mountains," by Frank D. Adams and W. J. Dick.
"The Zinc Occurrences at Notre-Dame des Anges, Que.," by J. A. Bancroft.
"Canadian Gold and War Finance," by Adam Shortt. This subject will also be discussed by J. Murray Clark.
"Rock Crushing Tests at McGill University," by J. W. Bell.
"Some Conditions Affecting Education in Mining and Metallurgy," by J. C. Gwillim.
"Mining Education," by L. D. Burling.
"Mineral Deposits of the Buckingham District," by Morley E. Wilson.
"Concentration of Ontario Magnetites and the Sintering Thereof," by an official of the Mines Branch of the Department of Mines.
"Copper Mining in Alaska" (illustrated with colored lantern slides), by H. W. DuBois.
"Petrolia, Past and Present," by J. Stansfield.

The annual dinner will be held at the Chateau Laurier on the evening of Thursday, Mar. 2. By the courtesy of Dr. J. Bonar, deputy master, members will be afforded the opportunity of visiting the Royal Mint. Arrangements have been made for visits under the guidance of members of the local committee to the ore-dressing laboratory and fuel-testing station of the Mines Branch of the Department of Mines, to the Victoria Museum and to the National Gallery.

Portugal Has Imposed a New Tariff Tax of 1.03c. per lb. on iron or steel shapes or plates for use in construction of buildings.

Mining in Ecuador*

By J. W. Mercer†

SYNOPSIS—Republic is rich in minerals, but only one mining enterprise is being operated, producing gold. Country most difficult to travel on account of lack of roads. Mining laws are liberal. Present mining in Zaruma district typifies most modern mining, sanitary and sociological methods.

There is in all of the republic of Ecuador but one mining enterprise in actual operation—the gold mines in Zaruma in the southernmost province. But it is not true, as published, that Ecuador is poor in minerals. True, it is almost undeveloped and not at all known, but there are surely many evidences of the possibility of great mineral wealth. How can a country be explored and developed without roads, to say nothing of railroads, and when senators from the extreme eastern provinces, wishing to attend the session of Congress at Quito, instead of ascending the rivers and crossing the mountains, deem it preferable to take steamer down the Amazon to the Atlantic Ocean, travel by steamship to Buenos Aires, thence across country and high mountains to Valparaiso and up the Pacific to Guayaquil, thence by rail to the capital?

General Aspects of the Country

The republic of Ecuador extends north and south along the Pacific more than 300 mi. and easterly about 500 mi. across the Andes Mountains to the tributaries of the Amazon River, thus containing an area of some 150,000 sq.mi. In population it is estimated to contain 1,500,000, but there has not been a census. In the larger cities and most of the coast section the mixed race predominates—that is, the Spanish-Indian—but in the intermountain sections the population is almost entirely native Indian. Of course there are many descendants from the Spanish and others and also foreigners from many countries. Guayaquil, situated about 830 mi. south from Panama, on the west bank of the River Guayas, 35 mi. north from the Pacific Ocean, claims a population of over 75,000 and is the most important seaport.

Ecuador is served by three steamship lines running between Valparaiso and Panama, and one of these conducts a coasting service between Guayaquil and Panama. River steamers ply on all the large rivers, connecting the small towns and plantations with Guayaquil. The Panama Canal puts Guayaquil within eight days of New York by steamer. The Guayaquil & Quito Railway Co. (New Jersey corporation) is the only railroad of any extent at present being operated. It is narrow-gage—about 42 in. There are a number of other railway projects under consideration and some under construction. The greater part of Ecuador is inaccessible and undeveloped because it lacks not only railroads, but wagon roads.

The immense uplift of the Andes Mountains throughout the entire length north and south of Ecuador has furnished a vast area for the prospector, but for many reasons the country is difficult of access. The lack of roads and railroads leaves the intermountain sections remote and inaccessible, and the fact that a great part of the northern central section is covered with volcanic ash and that a great part of the southern and eastern sections is covered with a dense growth of trees and jungle makes it almost impossible of exploration.

In the vicinity of Mt. Cotopaxi is a most interesting exhibit of various periods of eruption. In many places where the soil has been deeply cut by rivers and railway grades, there may be seen several layers of volcanic ash alternating with layers of black loam. In places the ash will be as thick as 6 ft. and the black loam as thick as 3 ft. It is noticeable that the thickest beds of ash are at a point opposite the volcano, while about 25 mi. away these layers thin down to a few inches and are much finer in texture.

In the tropical and semitropical reaches of the mountains, the rapid oxidation, disintegration and erosion, followed by dense floral growth, have so changed the face of the earth that it is impossible to know what may lie beneath. Even in the vicinity of ancient mine workings it is seldom possible to find the bottoms of the excavations exposed.

I believe there has not been made any geological study since that of Dr. Teodoro Wolf, therefore little can be said about the possibilities of Ecuador. Iron ore in workable quantity has not been discovered, neither have there been found any important deposits of lead, zinc and copper, although the latter is known to exist in several places.

Oil, Coal and Mercury Discovered

Oil has been discovered in the lands along the Pacific Coast west from Guayaquil, in the district called Santa Elena, and is now being explored. Indeed, it was discovered by the earliest voyagers, and Doctor Wolf in 1892 studied it and made report to the government. Since then a small extraction has been made from the superficial capping. In 1912 some considerable exploration was conducted when the deepest bore reached a depth of 2,000 ft. with negative results except in the superficial area. In 1913 the production was at the rate of from 10,000 to 20,000 barrels per year, being used locally as fuel for furnishing power. There are two grades reported by recent analyses: (a) Green, gravity, 24-28° Bé.; (b) black, gravity, 18-19° Bé. at 60° F.; both low in asphaltum, gasolene and kerosene and high in fuel and lubricating stocks.

Coal exists in various places—a low-grade lignite, high in ash and volatile matter. In the provinces of Azuay and Loja some quite wide seams have been discovered, but as yet they have not been developed to any extent and are lying idle.

Mercury has been discovered in the province of Azuay but has not been developed.

Silver was mined by the ancients and particularly in the district of Pillsum, province of Canar. In 1891-4 an attempt was made to explore these mines, and some ore

*Paper presented at the Second Pan-American Scientific Congress, Washington, D. C., and published by permission.

†General manager, South American Development Co., New York City.

shipped to foreign markets, but the mines were abandoned, probably for lack of capital and means of communication.

Gold is the only metal being produced in any quantity. I am unable to procure close figures as to the amount produced from the small placer work of the Indians, but am supplied with the figures for the vein mining, and I believe we may estimate the total amount of production at $600,000.

Gold probably exists in all the river gravels on both sides of the mountains. The Indians wash the gravels in many places and bring it in small quantities, to be sold to the banks and merchants. Particularly do they come from the mountain tributaries of the big rivers on the east side of the main watershed. I believe the Napo River and its tributaries at present contribute a small amount. Also, not far from the City of Cuenca, in the district known as Sigsig, the Indians wash out coarse gold and sell it in the large towns, but it is said that the whites are not permitted to enter that district. Again, in the extreme southeast a small amount of gravel washing is done and it is said that there are good prospects.

Near the northwest coast, in the province of Esmeraldas, a United States corporation conducted some extensive placer development, but about ten years ago this work was discontinued; it was said the reason for abandoning was that the gold could not be successfully saved. Platinum is reported to have been found in the gravels of some of the rivers in the northwestern part. In the province of El Oro, in the district of Zaruma, the river gravels contain small quantities of gold, but it is usually flaky and light and the gravel extremely shallow.

Traditions of Fabulous Riches

Tradition has it that in many parts of this country veins were known to contain gold in fabulously rich pockets. This has been assumed because of the vast quantities of gold plate, images and ornaments found in possession of the natives by the Spanish conquerors. However, we do not believe that there existed great treasure houses where the gold could be chiseled out in chunks, but suggest that it may have come from a long period of small gains. Probably the Spaniards were operating haciendas and employed their slaves, when not engaged in agriculture, in working the mines, and no doubt there were many independent natives washing the ores and gravels for small gain.

History tells us that soon after the Conquest the Spaniards discovered the natives working important gold mines at several places in Ecuador and founded several towns because of the mines. The principal ones were Zaruma, in the south in the province of El Oro; Zamora, in the southeast in the province of Loja; Sevilla del Oro and Logrona del Oro, both in the central part of the republic.

The Spanish governors were exacting more and more in the way of requiring the Indians to bring in large quantities of their gold, and after this had gone on to a point where they would not longer endure it, they organized several tribes and swept in one night upon the sleeping Spaniards, overpowered them and massacred all but the women and children, whom they carried away into captivity. One oft-repeated account is that to punish the Spanish governor-general of the town, they killed him by pouring molten gold down his throat, stating that they hoped he would be satisfied.

The mining laws of Ecuador are fairly liberal. A pertenencia, or lode mining claim, is 200 by 600 m., containing 12 hectares, or 30 acres. It is taken up by location and held by the payment in advance of an annual tax. This is 10 sucres ($5 United States money) for claims not in exploitation and 50 sucres for claims in exploitation. If the possessor should fail to pay his taxes during the month of January, he may still redeem the property by paying double tax the month following. If he should cease to pay taxes for a certain length of time, the property becomes subject to auction sale for the benefit of the government, at which time the original owner is allowed the first opportunity to buy in by paying the back taxes and the penalty. Mining machinery and supplies are admitted into the country free of duty, and the produce of the mines is not charged duty in exportation.

There are no smelting works or mints, and at present Ecuador has no means for the purchase and coinage of gold bullion.

Gold Mining at Zaruma

The Zaruma district is in the extreme south of the republic, in the province of El Oro, 150 mi. south from the City of Guayaquil. It is reached by steamer to Santa Rosa, thence muleback for 45 mi. The elevation is from 2,000 to 5,000 ft. above sea level.

It was just before the middle of the Sixteenth Century when Francisco Pizarro and his associates went in boats from Panama to Ecuador. Their first mainland headquarters was at a point where now is situated the town of Tumbez, at the mouth of the river of the same name and near the boundary between Ecuador and Peru. The river's source is 125 mi. to the east, formed of several large rivers that come out from the mountains. Amid these rivers and hills lie the mineral districts of Zaruma.

During the first years after the Conquest the adventurous Spaniard ascended the river in search of the origin of the gold found in the gravels until, arrived at the heart of the Zaruma district, he there found native Indians engaged in washing gold from the outcrops of large quartz veins. Here, in 1549-50, he founded the town of Zaruma. The famous road built under the rule of the wonderful Inca passes not far from Zaruma, and there may still be seen some stretches of the original stone pavement. Here they began mining for gold and subsequently explored and worked veins over an area at least 15 mi. in length north and south by 5 mi. wide. One may still see the marks of caves and openings denoting a vast number of old workings, for the most part filled with water, mud and vegetable growth and by cavings.

Most of the ancient mines are now inaccesible, though many give evidences of extensive workings. Entrance and exit were by shaft, tunnel and incline, and the ore was carried out on men's backs. The bottom of the oxidized zone, where they stopped mining, is usually 100 ft. beneath the surface, but the greatest of the ancient mines undoubtedly reached a depth of 300 ft. The only tools of metal ever found were some soft-iron bars.

The ore was treated by grinding and washing. A vast system of water ditches and reservoirs spread over the district. Hundreds of stone shoes and dies of the little two-stamp mills have been found in many places, and also the beds of old arrastres. The stamp mill consisted

of two stamps; the motor was a wooden box of the size of a modern candle box; the die an oval boulder having on its upper side two cupped out wells, into which dropped the stone shoes, smaller boulders with the upper end sharpened to a neck. This neck was driven into a wooden boss-head that extended up, tapering to form a stem on which was a wooden spike to serve as tappet. The cam was operated by means of an overshot waterwheel. The principle is the same as that employed today in our gravity stamps. After stamping they probably panned the free gold.

In 1815 Spain sent a representative, who reported that many mines were being worked, but after the war of independence mining soon fell off and almost ceased for a long time. In 1876 Doctor Wolf made a study of the district and in 1879 published a short description. In 1878 mining men from Chile and Peru came in and made the first mining-claim denouncements (locations), and in 1880 the Great Zaruma Gold Mining Co. was organized at London and began development. Two years were spent in road construction and attempts to introduce large machinery, but not having finished the road and the machinery being too heavy for muleback, it has lain abandoned at tidewater ever since. In 1883 the English company's manager joined the Salazar revolution and was killed at the gates of Quito.

Between 1883 and 1887 the English company raised additional capital, worked the mines and made some gold shipments. In 1887 it was liquidated and a new corporation, calling itself the Zaruma Gold Mining Co., was organized to continue development. In 1889 French capitalists investigated the district, but discontinued work the following year. In 1895 the English company abandoned the district entirely, its failure being due probably to lack of improved metallurgical methods and adequate means of communication with the coast. In 1897 a company was organized in the United States, took over the properties, began development and is still operating.

The Geology of the District

The geology of the district has not been finally determined, but it is probably large flows of andesite, dacite, rhyolite (some porphyritic and some brecciated) lying on the mica-schists that appear at the south end. This area has been extensively faulted and intersected by numerous veins of quartz and calcite, all probably containing some gold.

In the country rock a few pyrite crystals are found more plentiful near the veins; and within the veins there is often a heavy mineralization of pyrite, chalcopyrite, blende and galena. The quartz veins are often more than 15 ft. wide, and in some places many large veins lie parallel, forming a great mountain of quartz and country rock, with here and there ancient workings. On the surface the country rock decomposes rapidly, resulting in yellow and red clay. Ridges often indicate quartz, and many of the cañons are worn deep by decomposition and water. The area described is literally peppered with ancient workings, and in most places where recent development has penetrated beneath ancient mines, workable ore has been found.

The country is cut by several large north-and-south faults and numerous cross-faults. One may be traced for several miles with ancient mine workings along it. This fault frequently makes orebodies of quartz and calcite.

The entire vein matter contains fine particles of free gold, so scattered and small as to be invisible to the eye. Occasionally an exceedingly rich streak is found, made up of a black mineral, probably tetrahedrite, containing fine particles of free gold. Several vein systems have been developed and partly mined, the shoots ranging in size from 3 to 15 ft. thick and assaying in gold up to $30 per ton. In silver the ore may be counted to average $1 per ton.

Weekly development samples are taken from the various working faces, and after the ground has been opened, systematic sampling is completed. Several methods of stoping are employed. Where the walls are loose, close filling is carried on. In the veins of firm walls the shrinkage system is employed, while in some of the tight, narrow veins the stopes are left open, and in some cases pillars of vein matter are left over the level runway. Underground drilling is almost entirely by the air drill, using the one-man stoper, the jackhamer for sinking and both the mounted jackhamer and the regular drifter for development.

Long experience in milling has demonstrated the suitability of the cyanide process. There is neither smeltery nor mint in Ecuador, so all bullion must be shipped to foreign countries.

Water Power Developed

The power is all from water. There are a number of large rivers near the mines. The principal water-power installation is a 60-in. diameter concrete tube, 2½ mi. in length, delivering 6,000 cu.ft. of water a minute under a vertical head of 150 ft. The 40-stamp mill has an 8-ft. Pelton wheel on the lineshaft. In a like manner the crushers are driven, while the hoisting engine is operated by a 9-in. Francis-type turbine, reducing the speed through gears. From a low-head power another line drives three air compressors by means of Pelton wheels, directly connected. Concrete is employed for the tube instead of conducting the water in an open ditch, because of the fractured condition of the mountain and the certainty of land slides.

All machinery and supplies must be sectionalized for transportation by small mules. Mule-freight costs range from the best freight in the time of good roads at 1c. a pound to the most awkward freight in time of bad roads at 20c. a pound.

The available workman is a mixture of Spanish and native Indian stock, the type found in most of the towns and cities. The full-blood native Indian lives in the higher altitudes, cultivates the soil, seldom comes to the low country and does not care to enter the mines. The native need not work out, because he can live on rice and bananas and a few other foods grown by himself. But these Ecuadorians usually show ability and eagerness to learn and become good workmen as miners, drilling both by hand and by machine. They also become good mechanics. Since there are no other mines in the republic, they must learn here. The common laborer is counted not reliable, but those who do important work, such as mechanics, carpenters, drill runners, timbermen, mill helpers and clerks, are steady, especially so since the advent of free food.

The wage is based upon the work done wherever possible, and they like to be able to gain more by greater efficiency. Then, too, bonuses are given for extra steadi-

ness and accomplishment. The wage ranges from 50c. a day, in United States currency equivalent, for common labor to from $1 a day up for the miners, the latter based upon the meterage of hole drilled, and many miners can make $3 a day; all labor includes in addition free food. Over a long period the drilling speed has averaged 2 m. per shift per man for single hand-hammer work and 14 m. per shift per man for the machine stoper. There are at present employed 500 native Ecuadorians and 40 foreigners.

Because of extraordinary overhead expenses, such as traveling, agencies, attorneys, home office, hospitals, management, etc., with also excessive repairs and high transportation, costs must always be considerably higher than in similar operations in settled countries, and because of this it is all the more important in such an enterprise to attain large tonnage basis of operations, and that again calls for adequate transportation.

Because of its isolation and lack of railroads or other means of quick communication with the outside, there are many problems unusual at similar operations in well-developed countries and consequently extraordinary expenses. For instance, it is difficult and expensive to maintain an efficient crew and an adequate stock of supplies and machinery spares. The possibility of steamship delays and the bad condition of trails require that these needs be anticipated long in advance. Also, the language, laws and customs are foreign to most men employed in gold mining in the United States.

The climate is especially equable and agreeable. During the last 17 years the thermometer has ranged from 51° to 93° F. in the shade; the averages recorded for each day and summarized for the month are with almost no variation, average minimum 63°, average maximum 83°, average at 8 p.m. 70°. The rainy season begins in late December and ends with the close of April, the remaining seven months usually being without heavy rains. The average annual rainfall is about 60 in. During the rainy season brush and vines grow thick and to the height of a man, but by the end of the dry season all are practically burned up.

Sanitary and Hygienic Conditions at Mine

Distilled or boiled water is provided at all times, though the raw river water is dangerous only during the first excessive rains, when all the world is being washed into spring and river.

A medical staff is maintained and a constant fight conducted to prevent illness and to better the hygienic conditions. The methods employed at Panama have been followed and an energetic fight instituted against malaria, the hookworm and other ills of the tropics, but yellow fever and bubonic plague have never been here. The brush is kept cut, rubbish and garbage are removed daily, and dwellings are provided with screened quarters and running water. A community can be brought to the highest state of sanitation by proper care and prevention, but it is difficult to secure the coöperation and assistance of all the native population.

The mining company has introduced several welfare improvements: It has voluntarily given free food to all the workmen, deeming that this relieves them from the trouble of providing and cooking and makes for health, strength and steadiness; it also provides schools free to any child of the district; it operates a boarding house for feeding the staff employees and runs a garden where most of the temperate-zone vegetables and local fruits are grown for their benefit; large refrigerating rooms have been installed where meats may be hung and all cereals kept in full strength and free from insects; it provides a building used as a miners' club, a club for the staff and a chapel. The latest dwelling used by employees is a building of concrete—floor, walls and ceiling all reinforced concrete—the roof local tile, screened windows and doors. These are practically bugproof and sluiceable, so that roaches and fleas cannot harbor therein. Besides, this type of building is permanent, whereas those first built of ordinary lumber rapidly decayed from boring insects and rot. The native village and all staff dwellings are equipped with water, bath and sewer. For diversion, baseball, tennis, swimming, riding, dancing, etc., are indulged in.

Mining and Metallurgy in Australia

Special Correspondence

Mining here at the present time is in a bad way. The operating companies are having a hard time of it, both through lack of labor and general dissatisfaction of the men, and by reason of legislation that reacts against the whole industry.

The new "Metals Exchange," formed at the instigation of the attorney general, has never made known just what it is to do, but the exporting of ores, mattes and in fact anything but refined metal has been prohibited, and as the refineries are overloaded, there is but little hope for the small operator. The refineries are owned by the largest operators—Mt. Lyell, Mt. Morgan, Wallaroo & Moonta, and the Broken Hill companies—and I am informed that in order to get metals refined, all of the companies mentioned have had to put up considerable money for stock in the Port Kembla plant. The Great Cobar was informed that it would have to put up a certain sum toward the enlargement of the plant if it wanted any refining done.

Settlements for matte and blister copper are made on the London "standard" quotations, with a liberal discount for freight, refining, selling, insurance and sundries. With a difference of something like $80 per ton between "standard" and electrolytic, the producer of copper gets a fair cut taken out of his settlement.

The unions have put in application for all sorts of "things"—44 hr. a week, 2s. plus a 7% raise, extras for wet, hot or gassy places; two men on a machine at the same rate of pay, 2s. extra per shift for contractors, whether they earn day's pay or not, a half holiday for smeltermen on Saturday, no one-man machines to be used, two men on even a "plugger," and of course only union men to be employed. The evidence submitted to the Arbitration Court in a recent case was interesting reading. For absolutely silly remarks it makes George Ade's works read like the Aztec calendar stone.

For strikes and squabbles there can be no place on the face of the earth to compare with this country. A court award, binding supposedly on both parties, holds the employer, but not the employee. Strikers, if fined, do not pay the fines, and in place of "striking" or "walking out," they "stop work."

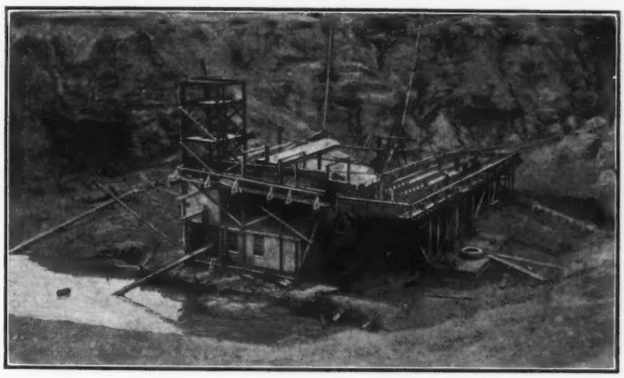
There is no doubt in my mind that the full realization of the war has not yet impregnated the minds of the majority of people here, and when the smash comes—and it is surely close at hand—you will have to dodge the pieces on Broadway. Wages have been going up, with a steady decrease in efficiency. There is no such thing as discipline in the ranks of the workers, the recruits, or in fact in the country.

The Great Cobar expects to blow in its furnaces this month. It is operating with about 350 men at the present time. It was enabled to resume operations only by the state of New South Wales advancing £40,000, the bondholders raising £60,000. If the mines were anywhere else than here, they could be made to pay out the greater part of their indebtedness.

A Victoria Tin Operation

The Cock's Pioneer Gold and Tin Mines, at Reedy Creek, Eldorado, in the Breechworth district of Victoria, Australia, operates a pump hydraulic-sluicing plant using electric power, according to the report of the Sludge Abatement Board of Victoria. The power, 1,200 kw. at 6,500 volts, is transmitted from a station 2 mi. downstream from the works.

The plant, as may be seen in the illustration, rests on a false bottom 70 ft. from the surface and is capable of elevating over 120 ft. and sluicing 16,000 cu.yd. of



COCK'S PIONEER GOLD AND TIN MINES, ELDORADO, VICTORIA

material weekly. The nozzle discharge is 4,000 gal. per min. The gold and tin deposits are estimated to be worth from £5,000 to £8,000 per acre. Two large areas, aggregating 148 acre-feet, are provided for retention and settlement of the discharged tailings in conformity with the provisions of the law.

The company's operations have been somewhat retarded recently because of water scarcity. In order to economize the supply it is, after sluicing, caught in the tailings dam and returned, to be used over again.

British Mineral Production

We published in the *Journal* of Oct. 2, 1915, the statistics of minerals produced in the United Kingdom from mines coming under the Coal Mines Act and the Metalliferous Mines Act, and from quarries. The British Home Office has just issued its general report on mines and quarries for the year ending Dec. 31, 1914, which gives the total production for the year. These figures are not repeated, inasmuch as the information can readily be obtained by adding the items as already published. However, the present report gives information as follows, not heretofore published, regarding metals produced from United Kingdom ores in 1914: Copper, 341 long tons; gold (bar) 99 oz.; iron, 4,786,090 long tons; lead, 19,378 long tons; silver, 146,444 oz.; tin, 5,056 long tons; zinc, 5,208 long tons. The total value of these metals at the average market price was £19,285,721.

Transportation in Alaska*

The railroads that have been constructed, together with other data such as mileage, terminals and gage, are given in the following table:[1]

Southeastern Alaska:	
White Pass and Yukon route, Skagway to White Pass (narrow gage). Terminal at White Horse, Yukon Territory—total mileage, 102 mi.	20.4
Yakutat Southern Ry., Yakutat to Situk River (narrow gage)	9.0
Copper River:	
Copper River & Northwestern Ry., Cordova to Kennecott (standard gage)	195.0
Kenai Peninsula:	
Alaska Northern Ry., Seward to a point near head of Turnagain Arm (standard gage)	71.6
Yukon Basin:	
Tanana Valley Ry., Fairbanks and Chena to Chatanika (narrow gage)	46.0
Seward Peninsula:	
Seward Peninsula Ry., Nome to Shelton (narrow gage)	80.0
Paystreak branch, Seward Peninsula Ry. (narrow gage)	6.5
Council City & Solomon River Ry., Council to Penelope Creek (standard gage)	32.5
Wild Goose Ry., Council to Ophir Creek (narrow gage)	5.0
	466.0

The coastal terminals for railways in Alaska are comparatively few even after the broad mountain barrier which screens the greater part of the territory has been broken through.

According to Alfred H. Brooks, member of the recent railway commission, the geographic features limit the routes to four zones, as follows: (1) the Chilkat basin, (2) the Alsek basin, (3) the Copper basin and (4) the Susitna basin. The rivers after which the basins are named indicate the general position and direction of the routes.

The three districts first outlined may be designated as follows:[2] A, the western; B, the middle; and C, the eastern. The railways that have been proposed and constructed or partly constructed are given below:

DISTRICT A

Chilkat Inlet Railway and Navigation Co.
Alaska & Northwestern Railway Co.
Chilkat & Yukon Railway Co.
Haines Mission & Boundary Railroad Co.
Dyea & Chilkoot Railroad Co.
Chilkoot Railroad and Transportation Co.
Chilkoot Pass Transportation Co.
Pacific & Arctic Railway and Navigation Co.
American & Canadian Transportation Co.
Yukon Railway Co.
Yukon Mining, Trading and Transportation Co.
Juneau, Douglas & Treadwell R.R. Co.
Alaska Southern Railway Co.
The Setuck Railroad Co.
The Yakutat & Southern Railway Co.*

DISTRICT B

Alaska Central Railroad Co., Valdez to Yukon River, etc.
Alaska Central Railway Co., Resurrection Bay northerly, etc.
Alaska Pacific Railway and Terminal Co., Controller Bay.
Akron, Sterling & Northern Railroad Co., Valdez east and north
Alaska Home Railway Co., Valdez easterly
Copper River & Northwestern Railway Co.,* Controller Bay, etc.
Copper River Railway Co.,* Orca Bay east and north
Katalla & Carbon Mountain Railway Co., Controller Bay north

*Constructed road.

*Excerpt from paper by W. R. Crane, Dean, School of Mines of the Pennsylvania State College, in "Official Proceedings of the Railway Club of Pittsburgh," Sept. 24, 1915.

[1]"Railway Routes in Alaska and Report of Alaska Railroad Commission," 62d Congress, 3d Session. Document No. 1346.

[2]"Railroads in Alaska." 60th Congress, 2d Session. Document No. 1201.

Hubbard-Elliott Copper Mines Development Co. of Alaska
Valdez-Yukon Railroad Co., Valdez easterly
Valdez-Marshall Pass & Northern Railway Co.,* Valdez east
Bering River Railroad Co., Controller Bay (Kanak Island)
Tanana Mines Railroad Co.* (now Tanana Valdez Railroad Co.)
Valdez, Copper River & Tanana Railroad Co., Valdez east.
Cook Inlet Coal Fields Co., Cook Inlet
Alaskan Coal and Coke Co., Yukon River.

DISTRICT C

Alaska Coast Line Railroad Co., Nome along coast
Bering Sea & Council City Railway Co., Nome to Council City, etc.
Council City & Solomon River Railroad Co.,* Solomon to Council City, etc.
Golovin Bay Railroad Co.,* Council City northerly and easterly
Seward Peninsula Railway Co.,* Nome northerly, etc.
Yukon River & Bering Strait Railroad Co., Teller to Council City, etc.
Wild Goose Railroad Co.,* Nome northerly
Nebraska, Kansas & Gulf Railway Co. (known as Alaska & Cape Nome Ry.)
Trans-Alaskan Ry. Co., Port Clarence easterly, etc.
Trans-Alaska Railway Co., Port Clarence easterly, etc.
Tin City & Arctic Railroad Co., Tin City northerly
Northwestern Railroad Co., only pier and terminal ground at Bering City.
Norton Bay & Yukon Railway and Navigation Co., Norton Bay
Alaska Short Line Railway & Navigation Co., Iliamna Bay

*Constructed roads.

That it has not proved to be an easy task to finance railways in Alaska is evident from the fact that out of the 45 that have been incorporated only 9 have had sufficient construction work done to permit them to be called railways, while in a number of instances the point has been stretched to allow of this, as less than ten miles of rails have been laid.

It is not likely that other railways will be built in Alaska by private capital for some time to come.

Ocean Transportation

Few of the seaports of Alaska are connected by roads of any description whatever, which means that they are more or less isolated and must depend upon boat service almost entirely. The harbors of southeastern Alaska, and extending to Cook Inlet in the Gulf of Alaska, are within 1,500 mi. of Puget Sound ports, being practically free from ice the year round. Six trips a month are maintained during the summer to the more extreme points, while the ports of southeastern Alaska have more frequent service. Winter service is maintained, but at less frequent intervals. Nome and St. Michaels are inaccessible during about three months of the year, steamers making trips direct from Puget Sound points. There is no regular and continuous service between Alaskan ports except those east of Cook Inlet.

The following steamship lines operate between Alaska and the States: Alaska Steamship Co., 13 boats; Pacific Coast Steamship Co., 6; Alaska Coast Steamship Co., 3; Western Alaska Steamship Co., 3; Northern Steamship Co., 2; Humboldt Steamship Co., 1 boat; Dodge Steamship Co., 1; Canadian-Pacific Navigation Co., 2 boats; various smaller lines, cannery vessels and small independent boats; total 31 boats.

The service from Puget Sound ports is approximately as follows: To Skagway, one passenger and one freight vessel every two days in summer and every three days in winter; to Seward, six passenger and two freight boats per month, and four passenger and two freight boats in winter; Cook Inlet points are served about once in every 23 to 25 days; Nome and Bering Sea ports have six combination passenger and freight boats, and from four to six freight boats call during the four months extending from June 1 to Oct. 1.

There are several large rivers in Alaska now serving a most useful purpose in the development of the territory, the most important being the Yukon, Porcupine, Tanana, Koyukuk, Innoko, Iditorod and Kuskokwim, which aggregate about 5,000 mi. of navigable waterways. The Yukon is navigable for fully 2,000 mi.; the next in importance is the Kuskokwim, navigable for at least 1,000 mi.; and the Tanana, although considerably shorter, passes through a fairly well-proven territory from the standpoint of natural resources. Connect these waterways with railways serving mining and agricultural districts and the rapid development of the territory will be assured.

The lines operating on the Alaskan inland waters are: Northern Navigation Co., 20 boats; White Pass & Yukon Route, 16; Merchants Yukon Line, 4; Cook's Inlet Transportation Co., 1; Georgie Steamship Co. 1 boat.

Cost of Road and Railroad Building

In order that an idea may be had of the cost of railroad construction in Alaska, the following figures are given, but are undoubtedly high and should not be considered as probable costs of such work in the future and under more auspicious conditions:

White Pass & Yukon Ry., $62,000 per mile; Copper River & Northwestern R.R., $75,000; Alaska Central Ry., $71,000 per mile.

Cost of wagon and sled roads and trails has been given as follows: Wagon roads per mile, $2,484; sled roads, $229; trails, $98.

The Alaskan Road Commission has had considerable experience in the construction of roads under practically all of the conditions that are known to exist in the territory, so that the figures given, while exceeding their estimate by a few dollars, are approximately accurate. It is claimed that it will cost $7,250,000 to complete the wagon-road system planned for Alaska, which sum will have to be secured from Congress with the exception of about $1,000,000 that will be available from territorial taxes.

Australian Gold Production

Preliminary figures have been received from all but two of the states of Australia for the gold production in 1915. The exceptions are South Australia and the Northern Territory; their output is small and can be closely estimated. The figures are given in the accompanying table in comparison with those for the preceding year.

GOLD PRODUCTION OF AUSTRALIA
(In Fine Ounces)

	1914	1915	Changes	
Western Australia	1,232,977	1,210,120	D.	22,857
Victoria	413,218	352,200	D.	61,018
Queensland	249,468	248,300	D.	1,168
New South Wales	124,507	145,962	I.	21,455
South Australia	6,258	5,500	D.	758
Tasmania	26,243	16,256	D.	9,987
Northern Territory	2,532	2,500	D.	32
Total Commonwealth.	2,055,203	1,980,838	D.	74,365
Total value	$42,481,045	$40,943,921	D.	$1,537,124

Some revision may still be made on the figures for 1915. It will probably be upward, especially in the figures for Tasmania. New Zealand published no monthly statements during the past year, and its production is still to be ascertained.

Camp Bird's Capitalization will be reduced, by a recent Chancery decree which consents to the reduction of the company's capital from £125,000 divided into 1,000,000 shares of 2s. 6d. per share each to £62,500 divided into 1,000,000 shares of 1s. 3d per share each, by cancelling paid-up capital to the amount of 9d. per share and by returning capital to the extent of 6d. per share in cash. Warrants for payment of the above return of capital were posted to shareholders on Jan. 7.

Storage and Handling of Explosives in Mines*

By Charles E. Munroe†

SYNOPSIS—There are 1,500 mixtures of explosive composition known, and the number will be greatly increased, it is expected, in the near future. In handling explosives thought should be given to natural as well as accidental causes of detonation. Any considerable quantity of explosive should be bought on specification. Bad practice to store different kinds of powder in one magazine. Detonators should never be stored with powder.

No treatment of this problem should be worthy of serious consideration which does not recognize the large number of variables, of opposite signs, that enter into it and that must be so balanced as to produce the best practicable and operative result. First among these variables is that of the explosives devised for use. Major Cundill, one of Her Majesty's inspectors of explosives, appears to have been the first to assemble, in 1889, in his "Dictionary of Explosives," a descriptive list of those recognized up to that time. This met with such acceptance that in 1895 (Lieut.-Col. Cundill having died *ad interim*) Captain Thomson, of the same service, brought out a second edition of this work, wherein it appears that at that time upward of 1,000 explosives were so sufficiently recognized as to be recorded. The value of such a presentation as that initiated by Colonel Cundill was so well recognized that similar publications, based on his, appeared in other countries, a notable and recent example being the "Dictionaire des Matières Explosives" by Dr. J. Daniel, published, with a preface by Berthelot, in Paris in 1902. It is difficult to enumerate explosives from Daniel's dictionary, because he includes the primary substances, many of which, as demonstrated by Berthelot, possess explosive properties, and which, as further demonstrated in such instances as that of the tri-nitro-toluenes, may be directly used as explosives in many situations, but it is not surprising that the number of explosives recorded by him markedly exceeds that of the 1895 edition of Cundill's "Dictionary." It is quite to be expected that in the intervening years the number has been added to greatly.

Growing Number of Explosive Compositions

For examples, one may note the report of the inspectors of explosives for 1910, when 29 explosives were added to the Authorized List and 22 to the Authorizable List, or 51 in all; or to its report for 1912, when 30 explosives were added to the Authorized List and 35 to the Authorizable, or 65 in all. A measure of growth may perhaps also be found in the "List of Permitted Explosives" of Great Britain, which in 1912 contained names and descriptions of 66 explosives, but five of which appeared in the Cundill "Dictionary" of 1895, and these five names seemed to be applied to other compositions than those set forth with them in the Permitted List. An analogous test of the growth in the number of explosives may consist in a comparison of those recorded in the "List of Permissible Explosives" of the United States Bureau of Mines with those of the dictionaries. Thus for 1913, in Bureau of Mines Technical Paper No. 52 we find 97 explosives enumerated, of which 80% at least are newly devised.

Time is not at command in which to search the literature for every explosive composition of matter proposed or in use, but it is not under the mark to affirm the belief that they number 1,500 and this number will undoubtedly be greatly increased in the near future. Naturally, since the dictionary records are historical as well as concurrent, the number of explosives in use at the present time is but a fraction, say 15%, of the total, and of these but a portion, say 70%, or about 150, are in use in mines today. These 150, however, exhibit many variations in properties. Thus the "Permissible Explosives" are, by the United States Bureau of Mines, grouped by their compositions into ammonium-nitrate, hydrated, organic-nitrate and nitroglycerin explosives, which renders it evident that the members of each class differ in properties from the members of each of the other classes; and since, as shown by the data presented in Bureau of Mines Technical Paper No. 52, the rate of detonation of each explosive in a class differs from that of any other explosive in the same class, it is correct to assume that it differs in its other behaviors and properties likewise, and so far as data on these points have been secured from experience or experiment, the assumption has been confirmed.

Many Factors Affecting Security from Accident

But to the inherent differences which characterize each explosive there are added in practice the differences arising in its manner of preparation for storage, transportation and use, such as the different forms and sizes of cartridges, the different kinds of wrappers in which the explosive is inclosed, both as to material and treatment, and the different ways in which the cartridges are packed, such as in sawdust or in cartons or in bags, like those that have been used with nondeliquescent free-running powders.

The differences pointed out constitute but a part of the variables entering into the problem whose solution is sought, and evidently, since the problem set involves as well all conditions and varieties of mining, it must be considered broadly to embrace all these variables. Security with efficiency will best be attained by regulations which are determined by the extreme properties of the members of the group. Such regulations will necessarily be exacting and severe. They may be modified in the case of a particular explosive from a special consideration of the properties of this single explosive, but this modifying should be done only by a properly constituted authority, such as a governmental official, or when no provision exists for action by such an official, only the employer or such person as must bear the responsibility in case of accident should be permitted to change the regulations, and he should be ready to prove that he was justified in doing so.

That this discrimination between explosives, due to an observed difference in their properties, is practiced may be proved by reference to the "Table Showing Distances

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†Dean, Faculty Graduate Studies, George Washington University, Washington, D. C.

from Protected Works for Magazines and Other Danger Buildings,"[1] prepared at the Home Office, England, where the distances between the buildings exacted for gunpowder are in repeated instances much less than those exacted for other explosives, or by reference to the British Order in Council of June 11, 1910, under Sec. 50 of the Explosives Act of 1875, whereby tri-nitro-toluol, which then was, and today is, widely used *per se* as an explosive and which is classed as a high explosive, was exempted "from being deemed to be an explosive during manufacture and storage unconditionally, and when conveyed or imported, provided it is properly packed,"[2] it being stated that this ruling for this substance was made "in view of its relative insensitiveness and freedom from danger properties."

I do not cite these examples in indorsement of the action taken. In fact, some subsequent occurrences cast a doubt on the wisdom of the latter ruling. I simply wish to emphasize my opinion that there should be no relaxing of stringent regulations except on the advice or permission of a competent authority that can give an intelligent and satisfactory reason for making the modification, and that it should never be done simply for the sake of convenience or to save time, labor or money, for in the long run such a proceeding will be found to be poor economy.

Considerations in Handling Explosives

In dealing with explosives it is to be always borne in mind that their ability to explode is their most significant characteristic and that this may be initiated by a variety of means, such as heat, fire, detonation, or chemical reaction with other substances, or by causes which give rise to heat, such as friction and percussion; hence, although the different explosive substances manifest different degrees of sensitiveness in response to these initiating causes of explosion, they should always be so handled, stored and used as to protect them from all of these influences up to the moment of use. No explosive should ever be accepted unless it is packed in strict accordance with regulations such as those of the United States Interstate Commerce Commission governing the transportation of explosives.

Explosives Should Be Bought on Specifications

Where any considerable quantity of explosive is to be used, it has been found wise to purchase the material on specifications drawn so as to cover not only the quantity, composition, size of sticks, method of packing and time and place of delivery, but also the date of manufacture. The importance of age in blasting explosives arises from the fact that not only will many of these substances undergo unfavorable changes by exposure to moisture or to dry air, and especially through successive exposures, and that the longer they are kept the greater likelihood of their encountering such exposures, but there are some among those in use which, even when carefully protected from moisture and dryness, nevertheless undergo changes that are made manifest, among other evidences, by a loss in plasticity of the cartridges, and with these changes in the constitution of the mass there is a change in the reliability, uniformity of action or efficiency of the explosive. I have already set forth elsewhere the necessity of securing and preserving uniformity in explosives.[3] Of course, where "Permissible Explosives" are purchased, it is unnecessary to specify composition, for such explosives to be "Permissible" must have the composition found at the Testing Bureau for them when they are placed upon the list.

Best Practice in Storing Explosives

As soon as the explosive in the original packages is received, it should be placed in the storage magazine. This magazine should never be within the mine itself, and it should be so situated at the surface that the explosion of its contents will not affect the mine or injure the machinery by which it is operated or the devices by which it is ventilated. This magazine should also be so situated as not to menace the highways, railways, dwellings, schoolhouses or other buildings in the neighborhood or the approaches to the mine. Some of the states have already enacted laws governing this matter. Where such do not exist, a guide may be found in the English Table of Distances already alluded to and in the proposed American Table.[4] Naturally, in placing this magazine due consideration should be given to the readiness with which it may be approached from road or railway for the delivery of explosives to it and the readiness and ease with which the supplies may be conveyed from it to the mine where they are to be used. The boxes of explosives should be so placed that the cartridges lie on their sides, and these boxes should be turned over at least once a month if they contain any liquid explosive, such as nitroglycerin, as a component of the mixture. They should not be stacked higher than the height at which the magazine storekeeper can easily reach them when standing on the floor, because he may otherwise, when attempting to remove the upper boxes, allow one to drop, which is hazardous. The explosives should be so stored that each consignment is in a pile by itself, and the older explosives should be used first, purchases being made, if possible, with such relation to the stock on hand and the rate of consumption that none of the supply becomes more than four months old.

It is considered bad practice to store different classes of explosives in the same magazine, members of the nitrate class such as black blasting powder being, in good practice, stored apart from those of the nitroglycerin class. It is apparent that if explosives of the hydrated class were stored in the same with a dry deliquescent explosive, circumstances might occur through which not only would the hydrated explosive become more or less completely dehydrated, but under which the deliquescent explosive would absorb more or less moisture and thus both explosives would have deteriorated. Another, though less important reason, for having but one kind of explosive in a magazine is that where there is more than one kind present and an accident of the kind styled "spontaneous explosion" occurs, there is always something of a doubt as to which of the explosives gave rise to the accident, with the result that there may be a loss of confidence in a really trustworthy explosive.

Under no circumstances should detonators or electric detonators (commercially known as blasting caps, dynamite caps, electric fuses, electric igniters and by other names) or any similar devices containing fulminate or

[1] "The Manufacture of Explosives," Oscar Guttmann, Vol. II, p. 379; 1895.

[2] Thirty-fifth Ann. Report. H. M. Insp. Exp., p. 3; 1911.

[3] "The Standardization of Explosives," Charles E. Munroe, Proc. Am. Soc. Testing Materials, 9, 638-41; 1909.

[4] Bulletin No. 80, U. S. Bureau of Mines, p. 99 (1915). By Charles E. Munroe and Clarence Hall. Also Bulletin No. 75, U. S. Bureau of Mines, p. 38, by W. R. Ingalls, J. Parke Channing, J. R. Finley, James Douglas and John Hays Hammond.

detonating compositions be stored in a magazine with other explosives, nor so near such a magazine that if the entire stock of detonators were to be exploded *en masse,* as by fire or a stroke of lightning, this explosion would cause the detonation of the contents of the large magazine.

No other substances or things besides explosives, recording instruments and magazine shoes, and perhaps magazine clothes, should be allowed in an explosives magazine. Tools of all kinds, paint supplies, oily waste or rags, or any other thing which may give rise to fire should be especially prohibited. The storage magazine for explosives and the small detonator magazine should be placed in charge of a specially careful magazine storekeeper, who should be required not only to receive and issue all explosive supplies, to keep an account of them and to read the recording instruments, but to see that all regulations relative to the magazines are obeyed. He should see to it that the magazine is kept free from dirt and grit, that no explosive has become spilled upon or has exuded upon the floor or any of the boxes, that the packages are intact, that the ventilation is maintained in the best condition as determined by atmospheric changes, and that no one enters the magazine without first putting on magazine shoes and, preferably, wearing magazine clothes. The shoes should be of felt and sufficiently large to go over the ordinary footwear. They are to be kept just inside the magazine door and are put on and removed while the person is standing on the landing outside. The magazine suit is preferably a woolen union suit made without pockets, so that matches and metallic things, such as knives and keys, may not be carried into the magazines.

Temperature Considerations in Magazines

Where any quantity of explosive is being stored, it is the best practice to have the magazine fitted with maximum and minimum thermometers and with an hygrometer, in order that, by the adjustment of the ventilating system, the magazine may be kept within the desired limits of temperature so far as possible and that when the moisture content of the outer atmosphere is excessive, the volume of air passing through may be reduced. The instruments may be read by the magazine storekeeper, or they may be so devised as to make automatic records in the manager's or superintendent's office. The temperature of the magazine should not be allowed to exceed 90° F., and with nitroglycerin explosives it should be prevented, so far as possible, from falling below 52° F.

Should explosives be received at the magazine or become frozen while therein it should never be attempted to thaw them within the magazine. This should be done only outside the magazine in thawers or thaw houses such as are described in Bulletin No. 17 and Technical Paper No. 18 of the Bureau of Mines.

No boxes of explosives should ever be opened within a magazine. This should be done in a shed erected behind a barricade separating it from the magazines and other buildings and structures and from roadways or other routes of travel. The boxes of explosives, when nailed, should be opened by means of a hardwood wedge and mallet. No metal tool should be used. And no smoking should be allowed.

The explosives magazine should be dry, cool, well-ventilated, shotproof, fireproof and protected from lightning strokes. It should be so constructed and of such material that, should it by any chance be destroyed by an explosion of its contents, it will supply the minimum of inflamed or incandescent embers and of flying missiles. Such a structure is found in the Bureau of Mines magazine constructed of cement-mortar, which is described, with detailed specifications for its erection, by Clarence Hall and Spencer P. Howell, in "Magazines and Thaw Houses for Explosives,"[5] and the advantages it possesses are established by the results of the tests recorded there.

As to Storing Powder Underground

It is necessary that explosives be taken into the mine, but it is a debatable question as to the establishment of magazines underground. The English decision in this matter in so far as it relates to coal mines is quite explicit, for Statutory Rules and Orders, 1912, No. 511, states:

> **No explosive substance shall be stored underground in any mine. The owner, agent or manager of the mine shall provide a suitable place or places of storage aboveground for all explosives intended to be used in the mine and shall make suitable provision conveniently near the entrance of the mine for the storage of surplus explosive brought out of the mine at the end of each shift. If any explosive remains in the possession of a workman at the end of his shift, either he shall bring it with him out of the mine and return it at once to the place of storage provided for the purpose, or if the explosive is required for a shift immediately following, he shall deliver it personally to the workman succeeding him in his working place.**

And it further specifies the exact form in which the explosive shall be taken into the mine in the following:

> **No explosive shall be taken or used underground except in cartridges, and such cartridges shall be taken into the mine and kept, until about to be used for the charging of a shot-hole, in a secure case or canister containing not more than 5 lb., and a person shall not have in use at one time in any one place more than one of such cases or canisters. After Mar. 31, 1913, no explosive shall be taken or used underground except in cartridges of the diameter of ⅞-in., 1¼-in., 1⅞-in., 1¾-in., or 2-in., or in the ironstone mines in the Cleveland district, in cartridges of the diameter of 1⅛-in.**

I am not convinced that these provisions are altogether satisfactory. I doubt the wisdom of each workman carrying explosives in and out of a mine, for the chance of accident increases in almost geometric ratio with the number of persons handling explosives and the jeopardy to person increases with the density of beings about the locus of the explosion. I believe it safer and wiser that a shotfirer or other person, chosen for his intelligence, sobriety and reliability be entrusted with the conveyance of all explosives and explosion devices into or from a mine and their distribution there. These supplies should be taken into the mine at some other time than when the men are making their entrance or exit, so that in case of accident there may be a minimum number of men about the explosive. The time of entrance may be before or after a change in the shift as is found most convenient in operation. The quantity taken in should not exceed that required during or immediately after the working of the shift. This of course requires that the responsible authority shall keep himself informed of the actual progress of the work, the amount and kind of blasting to be done and the kind and quantity of explosive needed. But this requirement is only one which good management of necessity demands, and it is therefore not burdensome or inconsiderate.

If this practice of taking the entire quantity of explosives and explosion devices required in a single shift at once be followed, provision must be made for its storage during the shift until distributed to the working

[5]Technical Paper No. 18, Bureau of Mines; 1912.

places in the mine; and since the material must be protected from moisture, accidents of various kinds and improper distribution, it should be inclosed in a magazine of some kind. Such a structure should be so situated that, while allowing of convenient access from the various parts of the mine—that is, while being centrally placed with reference to the parts of the mine that are being worked—it shall be capable of the least possible damage to the means of access to and about the mine. It should be sufficiently remote from the regular routes of travel in the mine that there may not be any large number of persons near it at any time. It should be surrounded by barricades of loose noncombustible material that may serve to dampen an explosion and prevent its causing the explosion of gas-air or dust-air mixtures about or at least diminishing their magnitude. And finally it seems not impossible to, in many instances, arrange safety valves about the magazine alcove, room or chamber such as a lightly closed shaft, which may provide a vent similar to the explosion doors on blast furnaces and stoves in case of an explosion.

Open No Explosives in the Mine

No nailed or sealed boxes of explosives or explosion devices that require force to open them should be opened in the mine. They should be opened at the opening shed on the surface. Explosives should be taken into the mine in their original packages with the covers loose but secured, preferably by gummed paper strips. If smaller amounts only are needed, they may be conveyed in split market baskets, preferably lined with canvas and provided with a canvas cover, or in indurated fiber buckets provided with a cover of the same material or of wood, and small lots may be conveyed about the mine in similar containers. Under no circumstances should detonators or analogous devices be brought into the mine or distributed about the mine in the same containers with explosives. Primers—that is, sticks or parts of sticks in which the detonators are inserted—should be made up at the working place, but should there be found a good reason for making up a quantity in advance, they should be made, if in small quantity, in a secluded and mound-protected place within the mine, or if in large quantity, on the surface, and then they should be brought into and distributed in the mine entirely apart from other explosives. They should preferably be brought in just before distribution. There should be a strict accounting at all points for the explosives and explosion devices issued and used or returned.

In blasting, after charging the holes and before the blast is fired, a careful search should be made about the room or working place and any explosives and explosion devices not then used in charging these holes should be removed to a sufficient distance from the blast and so protected that they cannot be exploded by sympathy, or concussion or impact from them, and cannot possibly become commingled with the débris from the blast. The occurrences reported of explosives being found in mined coal as it reached the breaker or in merchant coal when being stowed indicate that this search has not always been thorough. A strict system of accounting will tend to promote efficiency in this direction.

The handling of explosives might be considered to include the loading of the holes. So much has, however, been written on this subject that it seems unnecessary to rehearse it further than to call attention, perhaps again, to Technical Papers Nos. 6, 7 and 17 of the United States Bureau of Mines, as containing valuable experimental data in reference to the loading and firing of charges. The last-mentioned, styled "The Effect of Stemming on the Efficiency of Explosives," by Walter O. Snelling and Clarence Hall, is possibly the most novel and original. It may be of interest to state that the manager of one mine has reported a saving of $50,000 in his explosives account in a single year by following the methods for using stemming taught by this research. More recently Edgar A. Collins has stated[6] that he has found in practice where 30% ammonia gelatin was being used in a given mine, a saving of 25% in quantity of the explosive was effected by increasing the depth of the tamped stemming above the charge, and that as a consequence the amount of explosives issued to the miners had been cut by 10 to 20% of that formerly issued.

Rights of Mine Stockholders

By A. L. H. Street*

The statutory right of a stockholder in a mining company organized under the laws of California to examine the company's mines and to take samples of the underlying ore and to recover a penalty for refusal to permit an inspection or taking of samples was recognized by the California Supreme Court in the recent case of Symmes vs. Sierra Nevada Mining Co., 153 "Pacific Reporter," 710.

"The purpose of the examination," declares the court, "is to arrive at the value of the property in which the stockholder is interested. Broadly speaking, that value is composed of two elements—the economical or uneconomical working of the mine, and the extent and richness of the orebody. One employing an expert to examine a mining property would view with amazement a report that declared there was an orebody of given dimensions, but that the expert had taken no samples, caused no assays to be made and could place no valuation upon that orebody."

The court also decides that the law applies as fully to mines owned by a California corporation in another state as to those within the state.

Spanish Pyrites Imports

Importations of pyrites into the United States in 1915 from Spanish and Portuguese ports amounted to 912,572 long tons, according to the Davis Sulphur Ore Co., of 82 Beaver St., New York. The shipments by ports were: Huelva, 839,296 long tons; Seville (peña del Hierro), 37,654; Pomarão (Mason & Barry), 35,622 tons. In 1914, the shipments from these ports to the United States amounted to 854,432 tons.

Guatemala Will Retain Exclusive Control of the oil deposits of that country. A presidential decree in a recent number of El Guatemalteco specifies that deposits of oil and hydrocarbons may be acquired or worked in no other way than by lease from the government for terms of not more than 10 years, and such leases will be made only to native or naturalized Guatemalans. Special regulations are to be issued, giving in detail the terms on which oil lands may be leased.

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*Attorney, 829 Security Building, Minneapolis, Minn.

6"Min. and Sci. Press," Vol. 110, p. 790, 1915.

Details of Practical Mining

Pipe-Straightening Device

By C. Carleton Semple*

At any mine where the underground workings are extensive and considerable development work is done, as old stopes are abandoned and new ones opened, taking down and resetting pipe lines results in the throwing out of badly bent or twisted pipes which are ultimately sent to surface to be straightened prior to being used again. Straightening such pipes by hand is a slow process and may often require a greater expense for labor than the pipes are worth, or the hard sledging to which they must be subjected may open the seams in lap-welded pipe, making it unfit for further use.

At the Tonopah Belmont mine at Tonopah, Nev., Mr. Hendricks, the master mechanic, has devised for straightening pipes a simple machine which he claims so increased the product that two men could turn out enough work in a few shifts to save the cost of making the straightener.

This straightener was made of an 8x12-in. Joshua Hendy jaw crusher that was no longer required for crushing and had been lying about unused for some time. The straightener was made by taking out the toggles, jaw and jaw plates, retaining only the crusher frame, the pitman, with its shaft and eccentric, the driving pulleys and the flywheels.

The opening that had been occupied by the jaw plates was filled with a block of wood *A*, as shown in the accompanying sketches, and upon it was laid a piece of square flat steel *B* nearly as wide and long as the opening in the crusher. The pitman *C* was then turned over to a horizontal position, as shown in the sketch, so that its toggle end rested upon the plate *B*. To each of the projections of the crusher frame *D* that formerly carried the movable jaw shaft, an L-shaped piece of strap steel *E* was bolted so that the shorter leg of the L projected inwardly, and over the top of the pitman. The pitman thus confined beneath the L-shaped pieces would slide back and forth in a horizontal plane upon the plate *B* when the pulleys were turned.

Two guide plates *F* about 6 in. high, 1 in. thick and as long as the width of the crusher, were bolted in a vertical position on the crusher frame. These guides were bored at the center to receive a piece of 3-in. or 4-in. shafting *G*. The details of this piece of shafting are shown in the sketch. One end is threaded, the other provided with a fixed collar and cut down to a lug to engage in a recess in the end of the pitman. A stout spiral spring *H* covers that part of the shaft between its collar and the innermost of the two guide plates *F*. A checknut *I* fits over the threaded end of the shaft on the outside of the outer one of the guides *F*. An internally threaded steel sleeve *J*, carrying a steel fork-piece *K*, screws onto the projecting threaded end of the shaft. Two heavy strap-steel pieces *L*, bolted to the frame of the crusher as shown, completed the device. By means of the threaded sleeve *J* and the locknut *I* the distance from the inside face of the pieces *L* to the inside face of the forked piece *K* can be adjusted as required.

In use the device is driven by a belt, but very much slower than a crusher would be. The bent pipe is laid across the brackets *L*, the convexity of the bend lying in a horizontal plane and facing the fork *K*, which, being moved back and forth in a horizontal plane, forces in the bend of the pipe. The spring *H* causes the shaft *G* to follow the pitman on its back stroke. Lengths of pipe as crooked as the proverbial snake's back are service-

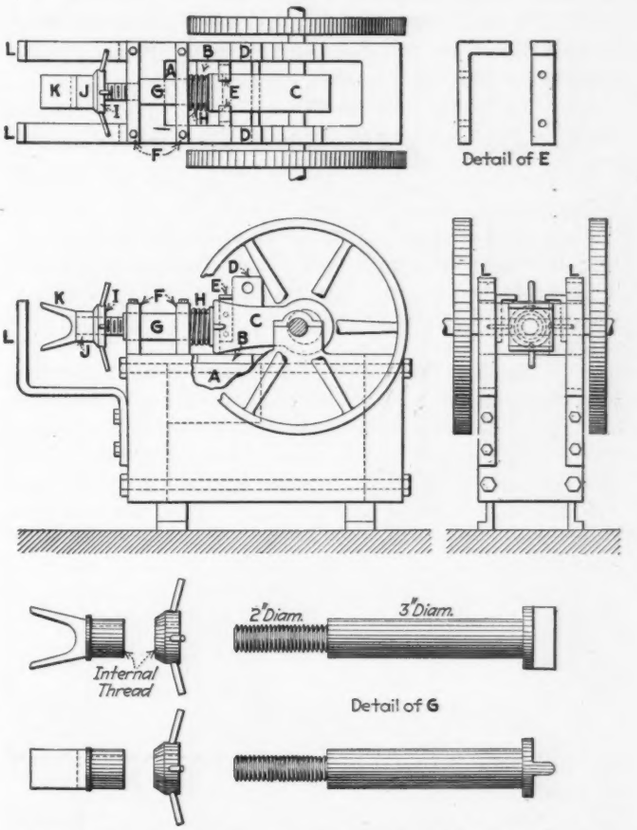


FIG. 1. TONOPAH-BELMONT'S PIPE STRAIGHTENER

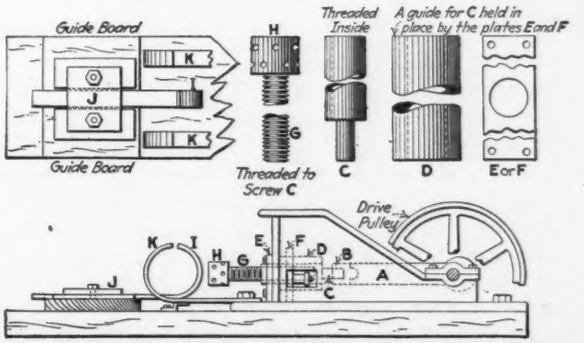

Guide Board
Guide Board
Threaded to Screw C
Threaded Inside
A guide for C held in place by the plates E and F
E or F
Drive Pulley

FIG. 2. PIPE STRAIGHTENER OF TONOPAH MINING CO.

*Mining engineer, Stamford, Conn.

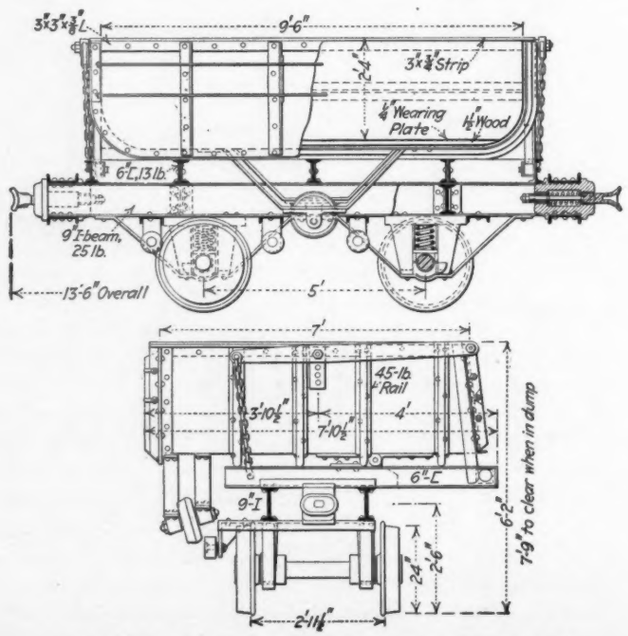
ably straightened by this device at the Belmont mine in an astonishingly short time.

In Fig. 2 is shown in elevation a similar device used at the shops of the Tonopah Mining Co., a different type of crusher from that employed at the Belmont having been used. In the figure, *A* is the pitman, to which a piece *B* is secured and within which is fixed the end of the part *C*, which is a hollow cylindrical piece of steel internally threaded to take the piece *G* with its capstan head *H*. *D* is a cylindrical casting held in place by the plates *E* and *F* top-bolted to the crusher frame. This casting *D* is bored to receive *C* for which it is a guide, *C* reciprocating through it when the machine is in motion. The adjustment is effected by screwing *G* into or out of *C*. The capstan head *H* strikes against the curved strap *I*, which is guided by the plate *J* and a guide board on each side. A similar curved strap *K*, but curved in the opposite way from *I*, is bolted to each side of the front of the crusher frame and about eight inches to the side of *I*. The pipe to be straightened is held by the straps *K* against the force of the blows that drive the strap *I* against the bend in the pipe.

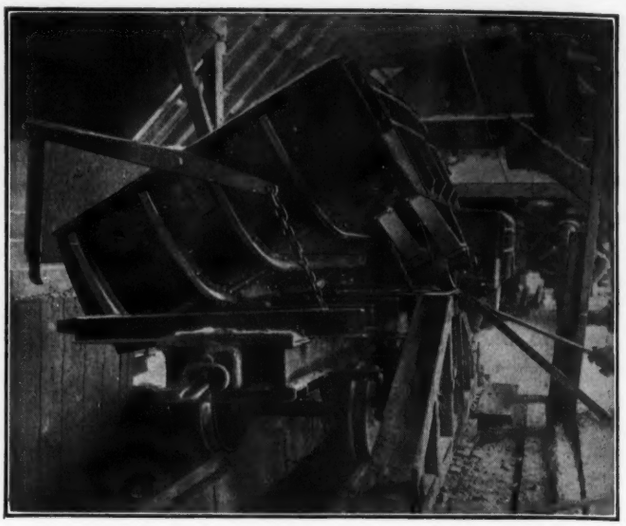
Granby's 10-Ton Dump Car

At the Phœnix, B. C., mines of the Granby Consolidated Mining, Smelting and Power Co., Ltd., an electric shovel was installed last year to facilitate the handling of waste, of which there is an increasing amount. This waste is now run directly to the dump instead of finding its way to a lower level and being handled through the mine chutes. When the electric shovel was first installed, 5-ton side-dump cars were used to transport the material. For three months in 1915 the cost of ore from the No. 3 level, considerably over half of which was from the shovel, amounted to 75c. per ton, crushed and loaded in railroad cars; the cost per ton for handling all material (ore and waste) was 40c. per ton.

Attention was directed toward improving the haulage facilities, and in order to dump large pieces of waste, which are handled by the shovel with chains, the



GRANBY'S 10-TON AUTOMATIC SIDE-DUMP CAR



GRANBY CAR IN DUMPING POSITION

cars were increased in size, so that when the door is opened it will allow the passage of a rock 4 ft. in diameter. The cars, which are always heaped by the shovel, average 10 tons to a load and dump automatically, as will be apparent from an examination of the accompanying views. The new cars have expedited the handling of the waste and have reduced materially the cost of this operation.

Rock Drifting in the Morris-Lloyd Mine*

At the Morris-Lloyd mine, four miles west of the city of Ishpeming, a 9x10-ft. heading, without timber, was driven in the slate foot wall, which dips at an angle of about 85 deg. A distance of 2,960 ft. was driven in 240 working days. The best day's progress was 19 ft. 9 in., owing partly to a missed cut on the previous shift; the poorest day's progress was 12 ft. 9 in.; the average daily progress was 16 ft. 8 in.

The rock encountered was slate, graywacke and quartzite. The work was done on two 8-hr. shifts. Four miners and, for the greater part of the time, six muckers constituted the crew. The muckers alternated, one gang of three filling a car while three rested.

Throughout the work 80% nitro-glycerin dynamite was used. The fact that the drift paralleled the slip made it necessary to use a strong explosive to insure breaking the cut, as the ground was extremely tight. This also eliminated large chunks and threw the muck back a considerable distance from the breast, enabling the miners to rig up quickly for drilling the next cut.

As the ground varied considerably during the progress of the drift, it was necessary to vary somewhat the cut used. Fig. 1 shows the cut commonly employed for drifting in slate, and Fig. 2 for the quartzite and graywacke. In Fig. 1 holes 1 to 11 were drilled from the bar in one position and fired in one blast. To complete the square, all 14 holes were fired on the second blast. It was found that only when holes 5-6, and 9-10 intersected at their respective ends, were good results

*Excerpt from paper presented at Lake Superior Mining Institute, September, 1915, by J. E. Hayden, mining engineer, Cleveland-Cliffs Iron Co., Ishpeming, Mich.

obtained. This point was carefully watched, the shift-boss always testing these holes before each blast.

For the extremely hard ground, such as the quartzite encountered, the cut was made as in Fig. 2, the top 15 holes being fired in the first blast and all 19 holes to

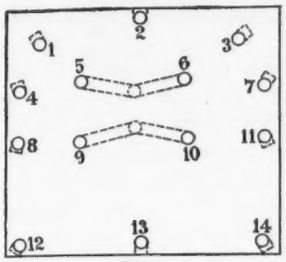


FIG. 1

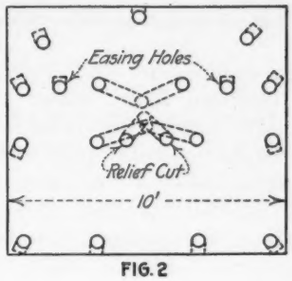


FIG. 2

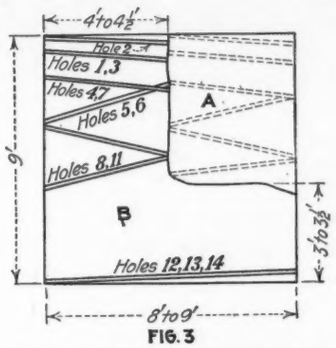


FIG. 3

DIAGRAM OF DRILL ROUNDS

complete the second cut and square. The two relief-cut holes (see Fig. 2) were drilled to meet at a depth of 3 ft. For the moderately hard ground, such as the graywacke, two easing holes were drilled, as in Fig. 2, instead of the 3-ft. relief cut.

Fig. 3 shows the cycle of operation to complete the square, *A* representing the portion removed in the first blast, *B* that portion removed in the second blast. Each shift blasted twice, completing the cut, leaving the drift squared at the end of the shift. During the entire progress of the drift there was but one slight injury, that being caused by a piece of rock hitting a miner's hand while he was barring down loose ground from the back. Following are the detailed costs of the 2,960 ft. of drift:

	Labor	Supplies	Total	Cost per Ft.
Miners	$8,430.27	$1,587.73	$10,018.00	$3.384
Mucking	8,169.03	.....	8,169.03	2.760
Tramming	1,117.92	498.39	1,616.31	.546
Explosives	.....	6,889.86	6,889.86	2.325
Air	.....	720.00	720.00	.244
Shop expense	460.00	230.00	690.00	.233
Machine repairs	135.50	1,196.27	1,331.77	.451
Air and water hose	.....	75.00	75.00	.025
Carbide	.....	95.00	95.00	.032
Total cost	$18,312.72	$11,292.25	$29,604.97	$10.000
Per foot	$6.18	$3.82		

Rubber-Soled Magazine Shoes

The mechanical hazards encountered in some industrial plants where inflammable and volatile liquids invite disaster from the striking of sparks by the nails of shoes on concrete pavements leads the "Travelers' Standard" to recommend a type of shoe in which the soles should be sewed and copper nails used in the heels.

Rubber-soled shoes are safe so far as the striking of sparks is concerned, but they are good insulators, and those who wear them sometimes become electrified by their own movements, to such an extent that sparks jump from their fingers when they touch metallic objects. To guard against this, a copper river should be driven through each rubber sole and headed over inside and outside. This will ground the wearer sufficiently to prevent the generation of dangerous sparks in this way. Similar precautions should be taken in the powder magazines.

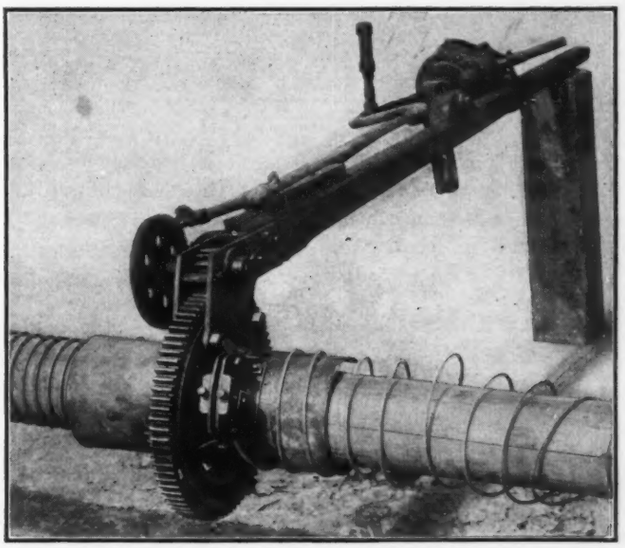
Continuous Wire Winding for Wood-Stave Pipe

A new type of wood-stave pipe has recently been developed in California and has been used in building two conduits of considerable length.

The new type of pipe is a continuous stave pipe wrapped with a continuous helical winding of wire. The wire is wound on the pipe after it is laid in place by a machine, illustrated in the accompanying cut, which winds the wire with a uniform tension and uniform pitch, both the tension and the pitch being adjustable according to the size of pipe and the water pressure to be used.

The machine has a gear wheel which encircles the pipe and is driven through speed-reduction gearing by a small compressed-air motor. As this gear wheel is rotated around the pipe it is at the same time given a longitudinal motion along it. This rotating gear wheel carries rollers between which passes the wire to be wound on the pipe, and these rollers are adjustable to give the wire the desired tension. The wire is unwound from a reel that encircles the pipe ahead of the machine.

When a new reel of wire has to be put on, the ends of the wires are welded together by a miniature electric



MACHINE FOR APPLYING A CONTINUOUS SPIRAL WIRE WINDING TO WOOD-STAVE PIPE

welder furnished with the apparatus. After the electric welding, the joint is regalvanized.

The first pipe of this type was laid about four years ago by the Standard Oil Co. of California, near Bakersfield, to furnish a water-supply to a refinery. The pipe is 18 in. in diameter, about 2,400 ft. in length, and carries a maximum head of 60 ft. Recently a longer pipe has been laid for the California Pine Box and Lumber Co., at Delleker, Calif., 6,500 ft. long, of 10-in. diameter, and under a maximum head of 200 ft.—*Engineering News.*

Details of Milling and Smelting

Gold Dissolution in Cyanide

Some interesting estimations have been made at the Sons of Gwalia mill of the proportions of gold dissolved in different parts of the mill, according to T. B. Stevens, in *Monthly Journal* of the Chamber of Mines of West Australia, Sept. 30, 1915.

In each case the estimates were made by determining the differences in the assay of solutions entering and leaving the machines and then calculating to tons of dry slimes. Of the total of 72.5% extracted by cyanide solution, only 28.7% is dissolved in the agitators, while 19.4% is dissolved in the grinding pans. Less gold is dissolved in the tube mills than in the pans, owing to the different character of pulp passing through them, the tube-mill pulp containing less slimes and higher specific gravity.

All the cyanide used in the plant is added in the form of a constant drip to the first agitator of the series, and the amount used is so adjusted that the free cyanide in the pulp leaving the agitation plant is not below 0.03% KCN. To maintain this, from 0.4 to 0.5 lb. of sodium cyanide per ton of ore is required. The accompanying table shows the location of the gold-dissolving centers.

GOLD DISSOLVED IN PLANT CIRCUIT

	Shillings per Ton	Percentage of Total Gold Dissolved
In mortars	0.5	1.5
In pans	6.5	19.4
In tube mills	2.7	8.0
In launders, classifiers and thickeners.	5.0	14.9
In agitators	9.6	28.7
	24.3	72.5
Amalgamated in pans	6.7	20.0
Left in residues	2.5	7.5
	33.5	100.0

Fire Refining of Bismuth

In a recent patent (U. S. Pat. 1,166,721) issued to Walter C. Smith, of Chrome, N. J., four processes of refining bismuth by fire methods are given. Preferably these are carried out in the order given here. The molten bismuth is first stirred with sulphur (elemental sulphur, sulphides, or a mixture of sulphates and carbon), and the resulting matte, containing nearly all the copper and the greater part of the contained tellurium, silver, arsenic, antimony, selenium and zinc, some of the tin, and a fair proportion of the lead, is skimmed off. This is most effectively done if the temperature be dropped to 515° to 520° F. after adding the sulphur.

The second process consists in adding caustic soda or other suitable alkali to the molten bismuth. This acts on the arsenic, antimony, selenium, tellurium, sulphur, tin and zinc that may be present, forming a fusible soda slag.

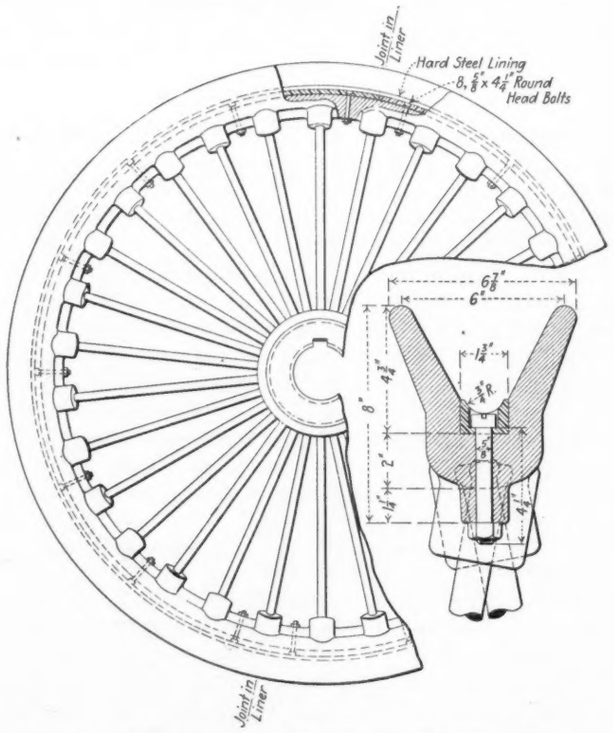
A third treatment consists in stirring in zinc, which affects tellurium, copper, gold, silver, selenium, arsenic, antimony and tin to form an alloy that floats in the bismuth. If, after stirring in the zinc, the temperature be dropped to 550° F., so much of the zinc will be eliminated that if other impurities be not present, the metal may be used for many purposes. If, however, complete removal of the zinc be necessary, this may be accomplished by another sodium-hydrate treatment.

If small quantities of lead, gold and silver still remain after this zinking, then factional crystallization in the manner of the Pattinson process must be used to remove them completely.

In the patent, which is assigned to the United States Metals Refining Co., Mr. Smith, in addition to describing these processes, gives lengthy reasons for their order of application.

A New Sheave Lining

To lessen the wear upon the rim of sheave wheels, as well as to render easy repairs thereto possible, the Litchfield Foundry and Machine Co., Litchfield, Ill., is offering a sheave with a new type of renewable wearing rim of hard steel, as shown in the illustration.



SHEAVE WITH NEW TYPE OF RENEWABLE LINING

Barium Chloride from Barium Sulphide and Chlorine

In a recently patented process of Einar Vang Granö, of Leonia, N. J. (U. S. Pat. 1,167,061), barium chloride is produced directly from barium sulphide and electrolytic chlorine.

A grid is provided with considerable space below it, for the sulphur that is set free by the reaction to settle in, the chlorine being introduced above the grid. In this way little sulphuric acid is produced by secondary reaction between the elemental sulphur and free chlorine, and an efficiency is obtained that is closely comparable with that of the process using barium sulphide and hydrochloric acid.

Collecting Powdery Material*

Materials in a fine state of division may not only be disagreeable and troublesome to handle, but frequently are of a distinctly poisonous character. If the flues of a smelting plant are built overhead and are suitably designed, the cleaning out is much facilitated, but the men engaged in drawing even the coarser dust and transferring it to other departments do not altogether escape its irritating and sometimes poisonous action on the system.

The last traces of solid matter are sometimes removed from the smoke by filtering through bags. In a case where the opportunity was afforded the author of making a departure in the moving of this class of material, the furnaces were producing a gas highly charged with arsenious oxide. This was, to a large extent, deposited in a complicated system of condensing chambers and flues, followed by filtration through bags. The points at which it was necessary to remove the arsenious oxide from the baghouse, flues, etc., were numerous, and it was also necessary to deliver all the material to the packing room, where it could be packed in casks for marketing. After considering the existing methods for removal and transport of this material, none of which appeared suitable, experiments were made with a powerful vacuum-producing plant, such as has lately been placed on the market and was originally used for the removal of dust from carpets and household furniture. This class of plant has lately been successfully adapted to the cleaning of boiler flues, and it appeared that such plant, with certain modifications, might be made suitable for the purpose in view. After some preliminary trials with a small plant and also with one of double size, an installation was designed and erected, of which the following is a description:

The vacuum pump at normal speed (160 r.p.m.) has a displacement of 20,000 cu.ft. per hr. and produces a vacuum of 18 in. of mercury if all valves to the various branch mains are closed. In the packing house the pipe main enters a cyclone separator in which the bulk of the arsenious oxide is deposited. Following this is another smaller separator. Finally the air is drawn through a shallow layer of water and then passes to the vacuum pump. The cyclone separator has a small storage capacity, and the arsenical soot is automatically removed from this apparatus and discharged into the casks placed below. The smaller separator is furnished with baffle plates and a collecting receptacle, from which the deposit is discharged only at long intervals when the vacuum is off. The water separator is arranged so that a small continuous supply of water can be passed through it, or it may be charged and discharged intermittently.

The mains about the works are of ordinary gas pipe, which need only be screwed together in the ordinary way. All bends and entering branches are of large radius, and for moving the material upward all vertical members are avoided and inclined pipes substituted. At numerous points about the works capped branches are arranged to which, on removal of the cap, suitable flexible hose can be attached; either flexible metallic hose or reinforced rubber hose answers well. A suitable nozzle is fixed at the end of the hose, and on inserting this into the accumulated deposit, the latter is immediately sucked up and conveyed to the separating plant.

This plant, having an air-pump capacity of 20,000 cu.ft. per hr., deals with 1½ to 2 tons of collected arsenious oxide per hour, and the farthest point at which a branch is situated is about 200 yd. from the separator. The pump in this instance is electrically driven and uses 12 to 14 hp. The ease with which collecting hoppers, condensing chambers, flues, etc., are cleared out is remarkable. The men work entirely from the outside, the nozzle end of the flexible tube being pushed into the material, which disappears in a surprisingly rapid manner and of course without the production of the slightest amount of dust. All the annoyance to the men caused by the handling of this material was removed, and respirators were superfluous.

*Excerpts from an article, "The Transport of Material in the Form of Dust," by T. C. Cloud, "Journ. Soc. Chem. Ind.," Jan. 15, 1916.

Electrolytic Tin Refining by Whitehead's Method

Of interest in connection with the establishment of a tin-smelting industry in the United States is a recent patent of R. L. Whitehead (U. S. Pat. 1,157,830) for refining tin electrolytically. He uses a 20% solution of hydrofluosilicic acid, to which is added 0.1% of sulphuric acid. Tin anodes and metal cathodes in porous cells are then immersed in this, and a current passed, dissolving tin from the anodes.

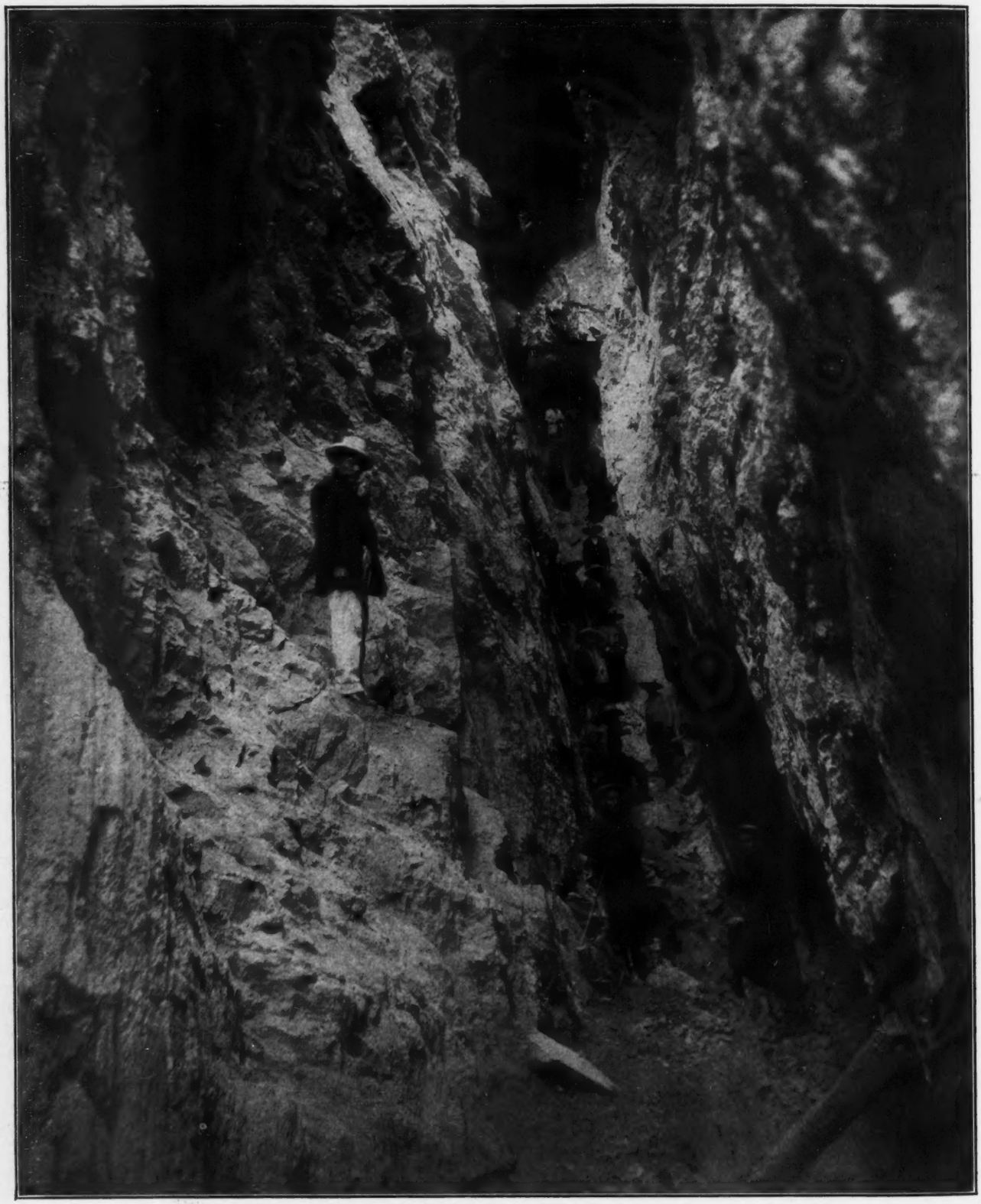
This is continued until the solution carries about 6% Sn. The porous cells are then removed, and deposition is carried with pure tin cathodes and impure tin anodes. The sulphuric acid prevents the lead in the anode dissolving in the bath, most of this, with the gold, silver and other impurities, remaining on the anode as slime.

High-Titanium Products from Ilmenite

A recent patent for the treatment of ilmenite for recovery of the titanic oxide present is that of Pieder Farup, of Trondhjem, Norway (U. S. Pat. 1,156,220). He treats the finely crushed ilmenite (or titaniferous iron ore) with sulphuric acid and heats until a solid sulphate mass is produced. This mass is then still further heated to about 600° C., during which heating the titanium sulphate is decomposed, the iron sulphate remaining unchanged. During this heating the material is suitable for a catalyst for contact sulphuric-acid making. The iron sulphate is then leached out with water, leaving a residue in which the titanium is greatly concentrated.

The Chief Use of Tungsten is for steel alloys, 85% being thus absorbed. Other uses are of minor importance. The lamp-filament industry, according to E. Maxwell-Lefroy (Bull. 135, I. M. M.), utilizes very small amounts, one ton of metal making filaments for 18,000,000 bulbs. It has even been asserted that this figure is too conservative.

Photographs from the Field



A VIEW IN LA DURA TUNGSTEN MINE IN THE TAMBORAS DISTRICT, NORTHERN PERU

THE 10,000-FT. TAILINGS-DISPOSAL CONVEYOR AT CHUQUICAMATA PLANT OF THE CHILE COPPER CO.

REVERBERATORY WIRE-BAR FURNACE, SHOWING THE CHARGING MACHINE, AT THE CHILE COPPER CO.'S PLANT AT CHUQUICAMATA, CHILE

Correspondence and Discussion

Record Tonnage Hoisted

With regard to a recent inquiry for the largest tonnage from a single shaft, I beg leave to call attention to the record of the No. 3 mine of the Superior Coal Co. at Gillespie, Ill., as probably the largest tonnage ever extracted in a single working shift of eight hours—namely, 5,196 tons.

This enormous output was made in a regular day's work; the usual tonnage hoisted in eight hours at this shaft ranges from 4,500 to 5,000, according to the smoothness of running conditions, ample railroad cars on the surface, etc. The length of hoist is 385 ft. from a two-compartment shaft, and the single-deck cages are self-dumping. The mine cars hold 6,000 to 7,000 lb., averaging about 6,000 lb. The engines are duplex, first-motion Litchfield design, 24x36-in. size. As the average is somewhat faster than three trips per minute, it is necessary to relieve the engineer every hour, as 200 trips per hour make a very severe demand on his close attention to the engines.

The No. 2 shaft of this same company has hoisted 5,133 tons in 8 hr., which very closely approached No. 3's wonderful record, and the No. 1 shaft has made as many trips, but as the cars are smaller, the tonnage ranges from 4,400 to 4,700 in 8 hr.

Nos. 14 and 15 shafts of the Consolidated Coal in the same district output from 4,000 to 4,500 tons, as likewise the Livingston shaft of the Staunton Coal Co.

The three shafts of the Superior Coal Co., which are under the able management of John P. Reece, output from 13,500 to 14,000 tons per day of 8 hr., as the hoisting is all done on the day shift.

St. Louis, Mo., Jan. 22, 1916. H. A. WHEELER.

Another Leasing Venture Making Good

Regarding the *Journal* editorial in the issue of Nov. 20, "Opportunities for Unemployed Mining Engineers," the time and conditions seem suitable for coöperation between mine owners and mining engineers or operators along the lines referred to—the organizing of a leasing and mining company, and operating in proven territory.

I am interested in a holding company that has spent much time and capital in acquiring a large group of gold mines and mining territory, water-power and a large acreage of land suitable for homes. The land is productive in fruit, alfalfa and vegetables and is well watered. The elevation is 2,600 ft., and the climatic conditions are ideal for living and mining operations. Good automobile roads run to three railroad lines, 40 mi. distant, and the territory is only a few hours' ride from Los Angeles and San Francisco. Mining conditions, for cheap production, are the best in the world, and preliminary work on several plans has been provided, as well as power and limited milling facilities. The mineral area is large, comprising small high-grade veins and a great width of low-grade formation, both in developed and undeveloped territory. The plan has been arranged for leasing purposes, with the idea of securing permanent operators who will establish homes and become a part of a large enterprise.

To encourage operators, leases will be granted on a basis of 25% of the net profit to the company, and on one plan air-drills will be allowed the leasers at the start, until gold production is on a firm basis.

The ore is quartz and quartzite carrying gold together with arsenical pyrites and traces of lead, zinc and iron sulphides. The average value is $10 per ton.

A leasing company, the members of which start without any capital except labor and mining experience, being supplied by the holding company with tools, etc., has developed a valuable lease, and the holding concern has a new property that will become a permanent producer. While some of the leases should have more labor expended than this one, which was a two-man lease, there are several that promise even greater ore backs for the same distance.

The *Journal* leasing plan agrees with my views and beliefs. In my opinion greater prosperity and permanency will result ultimately to the community and to the greatest number, once the method stated in its editorial is in full operation. The district in which the mining property is situated, Kernville, Kern County, is now free from saloons and hence very suitable for family residence.

Hayward, Calif., Dec. 23, 1915. C. S. LONG.

Institute Members on Naval Consulting Board

In reading the *Journal* of Feb. 5, I notice in the editorial, "Another Call to the Engineer Toward preparedness," it is stated that four members of the American Institute of Mining Engineers are members of the Naval Consulting Board. There are eight members of the Institute on that board: Thomas A. Edison, W. R. Whitney, Thomas Robins, W. L. Saunders, B. B. Thayer, J. W. Richards, Lawrence Addicks, and Spencer Miller.

The editorial states that the mining engineers are proud of this call, and the Institute of Mining Engineers has reason for more pride in having eight members on the board. GEORGE A. HOWELLS.

New York City, Feb. 5, 1916.

Leyner Versus Piston Drill

In the "Practical Mining" article under the caption, "Leyner Versus Piston Drill," in the *Journal* of Dec. 11, 1915, is given a table, showing in the final column the "average earnings per man per shift" of $2.89 for the Leyner drill and $2.71 for the piston drill. It is not clear to me why the earnings for the Leyner drill are not very much greater when the "average labor cost per drift foot" is for the Leyner $1.43 and for the piston drill $3.10. Perhaps Mr. Gordon will elucidate this point for me. M. R. PERCY.

New York City, Dec. 2, 1915

The Anaconda Betterments

On account of changes and improved results obtained in the reduction works of the Anaconda Copper Mining Co., an interim report has been issued to stockholders covering some of these improvements without going into the details customary in the annual report. To make plant changes recommended by the metallurgists of the company, approximately $6,000,000 and at least a year's time were required. The funds were obtained by the 2-year 5% note issue in March, 1915. The following information is taken from the statement of Feb. 14, 1916, by President John D. Ryan:

Improvements at Anaconda

Although the Washoe Reduction Works at Anaconda, judged by then existing standards, was an economical plant, developments in copper metallurgy had opened up the possibility of increasing largely the percentage of recovery of metals and decreasing the cost of extraction. The concentrator has been remodeled to permit the application of the flotation process for the recovery of the finer minerals and the capacity thus increased from 12,000 to 15,000 tons per day. The recovery of copper in the concentrates was increased from 82% to 96% with a comparatively small increase in the treatment cost. On a basis of 3% ore, this increased recovery represents 8.4 lb. of copper per ton of ore treated, together with proportional recovery of the precious metals associated with the copper.

For slimes treatment a separate flotation plant of 4,000 tons daily capacity was erected. In this plant 3,000 tons of current slimes and 1,000 tons of stored slimes are treated, this operation adding 900,000 lb. of copper to the monthly production at a cost of about 5c. per lb. A recovery of 90% of the copper in the stored slimes is made.

In addition to the metal losses formerly carried away in slimes, the coarse tailings contained about 11 lb. of copper per ton. Since the beginning of operations at the Washoe plant, these tailings have been saved and more than 20,000,000 tons is now available to be worked by the leaching process developed by the Anaconda metallurgists. The leaching plant has a capacity of over 2,000 tons per day and during the last quarter of 1915 treated 212,385 tons of tailings, from which an average recovery of 9.2 lb. of copper was made. Inasmuch as this material is already mined and crushed to sufficient fineness, the cost per pound of copper is much less than the average cost of the copper produced by the company.

New Roasting Plant Built

The greater tonnage of concentrates produced necessitated additional roasting capacity, and a new plant containing twenty-eight 25-ft. roasters has been built. The Cottrell system of fume precipitation has been installed to decrease the loss in the waste gases.

To supply the sulphuric acid needed for the flotation and leaching processes, the company has erected a 100-ton sulphuric-acid plant of the chamber type. Owing to the growing demand for sulphuric acid in this region, the management has decided to extend the plant and bring its capacity up to 150 tons per day of 60° Bé. acid. This addition is under way and will be completed in a few months.

The adoption of pulverized-coal firing resulted in the rebuilding of eight reverberatory furnaces having hearth dimensions of 23x143 ft., increasing the capacity per furnace from 250 to 650 tons per day, taking care of the increased volume of material, as well as reducing the smelting costs about 50c. per ton. Five new converters of the Great Falls type, 20 ft. in diameter, have been installed, increasing converter capacity from 19,000,000 to 24,000,000 lb. of copper per month and reducing the operating costs $1 per ton of copper. A large furnace has been erected to treat the converter slag, reducing the daily costs about $500.

Milling at Great Falls To Be Abandoned

It is expected that the concentrator at Anaconda will be large enough to supply concentrates for both of the company's smelting plants, and in consequence the concentrating department at Great Falls will shortly be abandoned, effecting a considerable saving by transporting concentrates from Anaconda to Great Falls instead of crude ore from Butte to Great Falls. The plans adopted for the smelting work at Great Falls involve remodeling the roasting department, rebuilding the reverberatory furnaces and equipping them for coal-dust firing and completing the installation of the large Great Falls type converters.

The increased output of the smelting plants of the company and of other customers of the Raritan refinery in New Jersey made it necessary to provide additional refining capacity. A study of the market distribution of the company's products resulted in the decision to build a modern electrolytic refinery at Great Falls, capable of an annual output of 180,000,000 lb. This plant was practically completed Jan. 1, 1916, but delay in starting was occasioned by the failure of manufacturers to deliver certain necessary incidentals. It is expected that the new plant will be in operation prior to Mar. 1 and that the cost of refining will be about $3 per ton less than at the old Great Falls refinery.

A process for the electrolytic refining of zinc has been evolved and patented, and the preliminary plant showed that it was possible to extract a high percentage of the zinc content of the company's ores while the other valuable metals were precipitated in the form of an easily reducible residue. The spelter contains about 99.9% Zn and is marketed as "Anaconda Electric" at a considerable premium over ordinary brands. The initial commercial plant, producing 20,000 lb. of electrolytic zinc per day, has been in operation for several months and is now being enlarged to 50,000 lb. per day. The production of this plant has been sold for a full year at an estimated profit of over $4,000,000. Construction has been started upon a plant at Great Falls capable of making an output of 70,000,000 lb. of zinc per annum, and it is expected to be in operation by autumn.

Development at Chilean Mines

The most important development carried on by the company outside of the Butte district was that done at the Potrerillos mines in Chile, where upward of 60,000,000 tons of ore of a profitable grade has been developed by churn drilling and only a small part of the mineralized area has yet been prospected; in addition it is believed that there is approximately 200,000,000 tons of lower-grade ore that can be worked at a profit. This property is controlled by the Andes Copper Co. and its subsidiaries, the Anaconda company owning 75% of the capital stock.

The Raritan refinery in New Jersey has been increased from a capacity of 360,000,000 lb. of copper per year to 440,000,000 lb.

Exact earnings of the Anaconda company for 1915 are not yet available, but estimates indicate net earnings of more than $16,000,000, with but little benefit derived from new processes that have only recently been put in operation. As a result of improvements made during the past year, the company will be able to add about 55,000,000 lb. of copper to its production without increasing the tonnage or grade of ore mined. Approximately 40,000,000 lb. of this increased production will be made without adding to the cost per ton of ore treated. The increased concentrating cost due to introducing flotation will be offset by decreased smelting cost. This additional copper at the average selling price represents in profit a sum that under previous methods could have been obtained only by increasing the tonnage of ore mined nearly 50%. The importance of making this addition to income without drawing on ore reserves is apparent. Owing to curtailment, comparison of results in 1914 and 1915 cannot be made, but applying the decreased operating cost and the profit on increased savings to the tonnage and grade of ore mined in 1913, the results at a market price of 14c. for copper would have added $7,000,000 to the net income of the company. The members of the staff are complimented by President Ryan on the successful conclusion of the campaign of improvements.

Twenty-One Dead in Mine Fire at Butte

BUTTE CORRESPONDENCE (BY TELEGRAPH)

Twenty-one dead—or missing—is the record of the most serious mine disaster that has ever visited Butte. Monday night, Feb. 14, a fire broke out in the 1,200-ft. level of the Pennsylvania mine, one of the Boston & Montana group of the Anaconda company. It was first discovered about 9 p.m., when the station of the air shaft at the 1,200 level was found ablaze. A quick alarm and heroic efforts on the part of safety-first crews prevented a much larger fatality, as 220 men were in the mine at the time. The cause and origin of the fire are unknown, but the officials of the company deny the rumors that an old smoldering fire in the adjoining property had eaten a way through into the Pennsylvania. In the rescue work the most heroic examples of sacrifice and daring were exhibited. Foreman William G. Mitchell, warned by physicians that he could not stand the use of a helmet, went into the mine without such protection in an effort to rescue some of the men and lost his life.

Neil Brennan, who had been ambitious to excel in safety-first work but had failed to win a place on the teams, sought an opportunity to show what he could do. He went into the mine with Mitchell and lost his life. Their bodies were the first to be recovered. The dead and missing are: William G. Mitchell, foreman, aged 38, single; Neil Brennan, 22, single; Peter Kelly, 51, single; William Dougherty, 49, single; Cebina Bardwell, 56, married; Bert Dulong, 33, married; George Tippem, 65, married; John Soderman, 32, single; Jack Brennan, 38, married; Fred Curnow, 18, single; Frank R. Dorres, 47, married; Frank F. Ferguson, 40, married; John Inch, 52, single; Frank McEnay, 47, single; William R. Reynolds, 34, married; Walter Steege, 22, married; Leo Whitmore, 31, single; Brance L. White, 19, single; Edward Pefferle, 24, single; Charles R. Self, 32, single; David Carlson, 43, married.

The bodies of all have not yet been recovered, but mine officials say it is not likely that any of them are alive. On some of the levels there are no connections with adjoining properties, and the only escape for the men was to climb to upper levels, where they found more gas than below. After the fire was discovered, connecting drifts with other properties were immediately bulkheaded, but some of the gas got into the workings of the Anaconda, St. Lawrence and Mountain View mines. Work has been suspended in these properties where several men were overcome, but it is expected that these mines can be reopened soon.

Engineers for Preparedness

More than 2,300 engineers—mining, mechanical, electrical, civil—tried to attend the first of the Monday night lectures held at the Engineering Societies' Building at 29 West 39th St., New York City, Feb. 14. These lectures, as announced in the *Journal*, page 306, Feb. 12, are under the direction of Maj.-Gen. Leonard Wood, and although the announcement stated that all engineers interested in preparedness would be welcome, between 500 and 1,000 were turned away from the building despite the fact that an overflow meeting accommodating 500 was held in another room on the fifth floor, where the same lecture was given as in the big auditorium, but by another United States Army engineer.

The speaker, Capt. Thomas M. Robins, of the Corps of Engineers, U. S. A., outlined very briefly the general scope of engineering problems in time of war, which résumé was given in the *Journal* of Sept. 18, 1915, page 467. Following this he exhibited an interesting series of lantern slides.

Railroad Strike in Alaska

Press messages of the last few days record the beginning of a strike on the construction of the Government railroad between Anchorage and the Matanuska coal fields in Alaska. A labor union was first formed with a membership of 600, and a strike was promptly called, the demand being for an increase of laborer's pay to 50c. per hr. The Government wage scale provides a minimum of 35c. per hr., while tracklayers received 37½c.

The members of the Alaska Engineering Commission, Lieutenant Mears being the only one in the North and the others in Washington, had nothing to say, but other officials believe that there will be no trouble in replacing the strikers, since the Government wage scale is higher and the hours shorter than those in force at the works of private interests in that part of Alaska.

New Mine Workers' Strike in Clifton District

Owing to the discharge of two union miners in the Clifton-Morenci district, over a thousand miners struck on Feb. 11. The discharged men were charged by non-union men with having threatened them with violence unless they either quit work or joined the union. A walk-out of 4,000 more men is feared. It is about three weeks since the general strike here was called off.

Editorials

Some Economic Vagaries in South America

Certain of the South American republics, especially Peru and Bolivia, have lately evinced a disposition to try some rash experiments in economics and finance. Among these have been the imposition of taxes on the export of mineral products, the granting of internal monopolies and the enactment of measures for the regulation of international exchange. Pursuit of the last is like the chase of a will-o'-the-wisp. Nothing can come out of it. In international exchange the natural law exercises itself freely and inexorably, and nothing that legislators may do can baffle it, not even for a little while.

Some of the South American republics are exhibiting a good deal of bad handling of their internal affairs, which is giving much concern to the more enlightened of their citizens, especially many of those engaged in the mining industry, who naturally have relations with the rest of the world. The intention of certain of their governments has made the outlook for the mining industry grave indeed, for the legislative bodies are, in the greater part, servile, and there is no such thing as a respectable press in a country like Bolivia, for example.

The governments of these countries should pause before they take some irrevocable steps. It is certain that no American capital will be invested in their countries unless their governments offer satisfactory guarantees, through treaties, that particular properties and commercial liberty in general will be respected—not only at the moment, but forever. American capital is now looking to foreign countries more than ever to find opportunities for profitable investment. A good deal of American money has already gone into South America, especially into Peru and Chile, and it has been assumed that South America was naturally going to be our great field for investment, just as Mexico was formerly. However, it is clear that American eyes are now turned largely in the direction of Russia. It is evident that South America is not going to be the only field open for investments.

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Gold Placer Mining in Russia

There is at present about 25% of all share capital interested in Russian gold mining in British hands. Practically no German capital is so invested, nor has there ever been any directly so invested. There has been, of course, German capital invested in British share companies having Russian interests. During the last 10 years the total area held under gold-mining rights has remained almost constant at about 439,000 sq.mi.

In 1915 there was a conference of gold workers to consider measures necessary to increase the output of gold. It was resolved: (1) The economic geology of the gold-bearing regions needs study; (2) duties and taxes need reduction; (3) foreign capital needs encouragement; (4) the formalities of government control should be lessened. It was further resolved that it is necessary to increase the interest in gold mining by: (1) Encouragement with loans from the Imperial Bank; (2) removal of duties on imported gold-mining machinery; (3) improvement of mining laws to encourage small-scale operations and prospecting; (4) establishment of a gold miners' bank to be under the direction of gold miners, to accommodate gold miners with loans; (5) improvement of roads. It was further resolved to be necessary to keep gold in Russia: (1) By preventing its export secretly over Chinese and Korean frontiers; (2) by measures to insure its handling in Imperial laboratories.

It will be observed that these are a mixture of practical and theoretical ideas. Some of the suggestions are excellent and necessary, but those smacking of paternalism, such as the establishment of a gold miners' bank, are neither practical nor beneficial. There is already too much paternalism, which frequently becomes obstructive, as for instance, the restrictions upon mining by foreigners in the littoral regions for 66 mi. from the coast along the Pacific Ocean. Particularly in the north, opposite Seward Peninsula, is a region of excellent promise, but neither foreigners nor Russians can mine there except by acquiring almost unobtainable rights, requiring much expenditure of money, time and patience. Were this and other similarly restricted areas thrown open, there would be an influx of efficient and energetic miners with capital and experience, from Alaska, and it is probable that there would be a considerable increase in the production of gold. Now there are no American small-scale miners at all in these regions, and there is only one foreign gold-mining company in the region on the east coast of Siberia from the coast line to a distance 66 mi. inland.

The policy dictating these restrictive measures is political as well as conservative and may be summed in the words, "Russia for Russians," but if Russia is to be intensively exploited, such restrictions must be removed. The makers of these laws have evidently overlooked the circumstances that much more than 50% of the gold produced in mining is spent at the point of production, in the purchase of supplies and for the payment of labor. No one in Russia seems to have considered that while there appears now to be a premium on gold, as seen in the augmented price at which it can be sold, there is a simultaneous reduction of its purchasing power, as evidenced in the increase of wages and prices. If the purchasing power of gold after the war be increased, say twofold, there are considerable areas of worked-out mines that could be reworked profitably by dredging on a large scale. But if this power be not increased or if, as is thought by many, it be decreased, it is probable that Russia, like other countries depending principally upon placers for its gold, will note an annual lessening of output as the placers are exhausted.

"One-man propositions," so numerous in Alaska, are rare in Russia, but there are many areas suitable for such work. At present most of the one-man propositions are worked secretly and illicitly, owing to the obstructive and unwieldy laws and the tardiness of their application.

What Russian gold mining needs, perhaps, more than anything else is such freedom of initiative and operation as will encourage one-man propositions to open the country. When once prospected and opened by small-scale operations, working by merged interests on a large scale will follow automatically, as it has in Alaska and Klondike under similar conditions of climate, transport and inaccessibility.

Things in Technical Literature That Are Not So

In the *Journal* of Sept. 18 we had an editorial under the caption, "Things in Technical Literature That Are Not So," in which we quoted a letter from a correspondent in South America, who complained of erroneous statements in certain descriptive technical articles relating to some mines in Bolivia. He concluded with the remark, "I have often thought to call those scribes to account, but after all did not think it worth while." To this we added the following comment:

We hold that it was not only worth while, but that it ought to have been done. The printing of erroneous statements in a technical magazine is apt to be perpetuated by the professors in their textbooks and treatises. Thus there creeps into permanent literature the recording of many things that are not so.

The correspondent whom we have quoted puts his finger upon the explanation of much of this. The editor accepts a contribution from a person whom he knows and believes to be reliable. It may turn out, however, that the contributor was deceived. There does not appear to be any effective way of preventing this. The only thing that can be done in most cases is to print a correction, and in the interest of everybody the readers of a paper ought to draw attention to misstatements that they observe in its pages.

Our South American correspondent has replied to this in the following interesting letter, certain personal references in which we have, of course, masked:

I note that you reproduced a part of a letter of mine in the "Journal" of Sept. 18 and say at the end that you think I ought to have corrected the misstatements. I should have been glad to do so, but this would have meant an enormous amount of work for me, for my corrections in several cases would have been longer than the original articles. Further, if one criticizes statements published by other persons, that he knows to be untrue by reason of general knowledge of the country or the people, it is not enough to contradict them. Reliable authorities must be cited to confirm the contradiction, and those are, especially in Bolivia, difficult to find. I will give an instance of this: In the first months of 1915 there was an article on Bolivia by L——— T———, especially on tin mining. I know Mr. T——— personally and know also that he would not write willfully things that he knew to be not so. According to him tin mining had come almost to a standstill, but when the article was published there was not one of the larger mining concerns of that country that was idle.

Further, he wrote something about tube-mills. I am almost sure that when he wrote the article, there was not one tube-mill running in Bolivia, although several had been bought and were being erected. At present there may be two or three of these mills in operation. If I had contradicted those statements, my letter would have appeared in the "Journal" some two or three months after the article on which I commented had been published, and in the meantime the tube-mills might have been started or several mines might have stopped working.

It is an ungrateful task to figure as knocker, and especially if you are not sure that by the time your criticism is printed, things may be the other way. I am entirely too busy to criticize everything that is written on Bolivia, although Mr. W——— would have given me another beautiful chance with his numerous articles. My time for technical writing is limited, and I prefer to spend this time in writing about technical subjects, not in finding fault with others.

I hope you will now see that there is a good reason for me and others who are in the same condition not to correct all the misstatements that are made. On the other hand, if I find anything wrong in strictly technical articles, I try to enter into discussion with the author and shall always continue to do so, because I feel much keener interest in metallurgical matter than in statistics or descriptions of general conditions.

All that is said by our South American correspondent is obviously so sound that no exception may properly be taken to any of it. It is not to be expected that any one man shall constitute himself the paladin of the truth in all matters, for no one is omniscient. The point that we made in our previous article was simply that technical men should take the trouble to correct misstatements respecting things they know. Nothing more than that could reasonably be asked of them.

The Flotation Process

The sensation of the day in mining and metallurgy is the phenomenal success of the flotation process. Introduced as an adjunct to the older methods of milling, the percentage of extraction of valuable minerals from ore has been raised in a remarkable way, and many ores that previously could not be exploited at all have now been rendered commercial.

Owing to the bane of a deadly litigation over the flotation process, the mouths of the mill men practicing the new art have in the main been closed. One result of this has been that the press has been full of sensational and misleading statements about flotation—statements which could not be authoritatively corrected. The woods are full of so-called mill experts whose sole equipment is a can of oil and a stirring device. Not long ago a mine in the Rocky Mountains, which previously had failed to command any attention, was sold on the strength of flotation experiments that required one hour to make.

According to the idea of the gullible public, you break down your ore in the mine and mix it with oil and acid and the trick is done. But that is not so. It is a complicated art. The mill man wants data about this art, not a collection of flowery phrases, merely explaining that flotation means that minerals are floated. The mill man wants to know fully and in detail how flotation is applied to individual ores.

Fortunately, some mill men who have had experience in the practice of flotation and have no property interests that might be endangered by law-suits are now beginning to take up their pens, and the literature of the subject is at last growing in a useful and authoritative way. There is no doubt that henceforth it will increase rapidly.

After all, flotation is not such a mysterious subject as many pretend. It is simply a species of mechanical concentration. As compared with ordinary processes, it is what was characterized in the *Journal* of 1907, in describing flotation as then practiced at Golconda, Nev., as "concentration upside down." In ordinary methods the valuable mineral is caused to sink. In flotation it is caused to rise. The great advantage of the latter method lies in its obviation of the slime problem, historically troublesome. Ore is now deliberately slimed, at all events crushed very finely, and the minerals to be separated are thereby fully released, which, together with other features of the process, enables a phenomenally high recovery to be made. The advantage of the process is measured by the raising of the old percentage of extraction in ore-dressing, 65 to 75%, to the present-day figures of 85 to 95%.

So far, the flotation process has been practiced chiefly in conjunction with the older methods of mechanical

concentration; that is, the ore is crushed relatively coarsely and jigged and tabled in the ordinary way, the middlings or tailings or both being then reground and treated in the flotation apparatus. It is probable that the next development will be to treat all of the ore by the flotation process. When that comes about, the troubles of the smelters in treating fine ore will really begin.

BY THE WAY

Members of the syndicate which underwrote the Kennecott-Braden-Utah transaction, by which the Kennecott Copper Corporation absorbed Braden and a substantial block of Utah Copper stock, have received checks aggregating approximately $3,400,000 for their work, and were not called on to furnish any cash, says the *Evening Post* of Jan. 25, 1916. Hayden, Stone & Co. bought from the syndicate all the Kennecott shares it had accumulated through the various exchanges of stock.

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A subscriber who has just returned from Mexico writes: We hope that during the present year we may have a chance to enjoy and utilize the valued *Journal*. We have been in exile for nearly two years practicing "watchful waiting" and hoping that the American people, whatever they may do, will some day awake to the proper realization of the horrors of failure to indorse the doctrine of "protection to American life and property." Conditions over all Mexico are still very bad, and although we are beginning to do something at Guanajuato, it is pretty hard sledding through almost total lack of transportation. The entire country is wrecked, and recovery will of necessity be slow. What can one do with a four-cent dollar?

⁂

The superintendent and the rock foreman sat in the shanty one rainy day, swapping yarns, says *Engineering and Contracting*. The talk drifted to hard rock work. "The hardest rock I ever came across," said the super, "was in a railroad cut in Pennsylvania I worked on about 10 years ago. We started drilling, and after wearing out three barrels of drills, the hole was only ½ in. deep." "That was sure some hard rock," replied the foreman, "but it wasn't nothin' compared to what I bucked up against in a mine in Nevada. We started drilling a ledge, and after using up seven barrels of drills the hole stuck out 6 in." Which reminds us of the man who had a fine gold vein than he had never been able to work, because there was an overlying stratum of solid silver that wore out the tools too fast.

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The discovery of the disseminated-lead deposits in St. Francois County in Southeastern Missouri was largely due to a fortuitous chance and the faith of Charles Parsons. The great lead-mining companies of this district have since taken up most of the available land in St. Francois County and to keep up their reserves must soon be seeking territory outside St. Francois County. Washington County, which adjoins St. Francois on the west, has long been regarded as the most favorable outside territory; the customary "shallow diggings" and the geologic formation both give promise of success to persistent prospecting, though deeper drilling will be necessary. "The more difficult, costly drilling in Washington County," writes H. A. Wheeler, "has been an important deterrent to the 'old timers,' as drilling in St. Francois County is so exceptionally cheap, rapid and easy that it has spoilt and unnerved them for crossing the county line, especially with their poor, home-grown drillers. It is therefore highly probable that the Washington County disseminated deposits will be opened up by outsiders, who, if they have drilled in Western or Northern mining camps, will regard the drilling as cheap and decidedly attractive, as it is entirely in flat-lying limestone and shale, with only occasional streaks of thin chert in the upper 400 ft. Thus far, in the few drill holes that have been bottomed in Washington County, the rare luck has not been duplicated that discovered the disseminated lead in St. Francois County. For when Charles Parsons, the pioneer who developed the great St. Joe mine, became discouraged nearly 50 years ago in working the shallow diggings at Bonne Terre, he placed the first diamond drill ever applied to mining in this country at the only spot in St. Francois County where the disseminated lead is shallow, or less than 100 ft. The original Leschot drill that he employed, which had recently come from France, was crude and with its cast-iron rods was capable of drilling only 200 ft. Had he employed it on any of the other numerous orebodies now being successfully worked in St. Francois County, he would have utterly failed, as they are 300 to 600 ft. deep and hence beyond the reach of this pioneer drill. The shallowness of the discovery of the disseminated lead made such a deep impression that for many years the holes were drilled only 200 ft. deep, even when the machines were more capable, and several condemned tracts were subsequently found very valuable when redrilled deeper."

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Getting Out The Ore*

"The air in Number Six is bad,"
The youthful shift boss said,
"And, if the gang ain't moved from there,
They'll all be laid out dead."

"Oh, damme, man!" said Cap'n Dan,
"Don't bother none about that air,
Don't give a hang about that gang,
Them wops live anywhere."

"Old Tony's boy is sick today,"
The youthful shift boss said,
"And still he's stickin' on the job,
He oughta be in bed."

"Oh, damme, man!" said Cap'n Dan,
"Don't let the rascal shirk,
Just keep the slob right on the job,
We'll cure him up with work."

"The timbers cry in Number Ten,"
The youthful shift boss said,
It's due to cave most any time,
Let's move the gang ahead."

"Oh, damme, man!" said Cap'n Dan,
"Them timbers ain't broke yet,
Just keep the men in Number Ten,
They'll be all right, you bet."

"Now don't you worry so, m'son,"
Old Cap'n Daniel said,
"'Bout these 'ere bloody miners,
For after we're both dead,

There'll miners be, undoubtedly,
Of that fact I'm quite sure,
So make the wops just buzz like tops
And get out lots of ore."

*By Charles Nicholls Webb, in the Virginia, Minn., "Daily Enterprise," Jan. 7, 1916.

NEW PUBLICATIONS

THE ELLAMAR DISTRICT, ALASKA. By S. R. Capps and B. L. Johnson. Pp. 125, illus. Bull. 605, U. S. Geological Survey, Washington.

DIRECTORY OF ARIZONA MINERALS. Compiled by Charles F. Willis. Pp. 16. Bull. 3, Arizona State Bureau of Mines, University of Arizona, Tucson.

PETROLEUM IN 1914. By John D. Northrup. Mineral Resources of the United States, 1914—Part II. Pp. 206. U. S. Geological Survey, Washington.

ARISAIG-ANTIGONISH DISTRICT, NOVA SCOTIA. By M. Y. Williams. Pp. 173. Memoir 60, Canada Department of Mines, Geological Survey Branch, Ottawa.

THE PRODUCTION OF COAL IN 1914. By C. E. Lesher. Mineral Resources of the United States, 1914—Part II. Pp. 160. U. S. Geological Survey, Washington.

THE OIL AND GAS FIELDS OF ONTARIO AND QUEBEC. By Wyatt Malcolm. Pp. 248. Memoir 81, Canada Department of Mines, Geological Survey Branch, Ottawa.

INTRODUCTORY NOTES ON QUANTITATIVE CHEMICAL ANALYSIS. Third Edition. By Charles William Foulk. Pp. 250, illus.; $2. McGraw-Hill Book Co., Inc., New York.

ORIGIN OF THE ZINC AND LEAD DEPOSITS OF THE JOPLIN REGION, MISSOURI, KANSAS AND OKLAHOMA. By C. E. Siebenthal. Pp. 283, illus. Bull. 606, U. S. Geological Survey, Washington.

NATURAL GAS RESOURCES OF PARTS OF NORTH TEXAS. By Eugene Wesley Shaw, George Charlton Matson and Carroll H. Wegemann. Pp. 126, illus. Bull. 629, U. S. Geological Survey, Washington.

SURFACE WATER SUPPLY OF OREGON, 1878-1910. By F. F. Henshaw and H. J. Dean. Prepared in Coöperation with the State of Oregon. Pp. 829, illus. Water-Supply Paper 370, U. S. Geological Survey, Washington.

REPORT ON THE COPPER DEPOSITS OF THE EASTERN TOWNSHIPS OF THE PROVINCE OF QUEBEC. By J. Austen Bancroft. Pp. 295, illus. Department of Colonization, Mines and Fisheries, Quebec, Canada.

HANDBOOK OF TABLES AND FORMULAS FOR ENGINEERS. Compiled by Clarence A. Peirce; with mathematical sections by Walter B. Carver. 4x6¾, pp. 168, illus., leather; $1.50. McGraw-Hill Book Co., Inc., New York.

EXTRACTION AND RECOVERY OF RADIUM, URANIUM AND VANADIUM FROM CARNOTITE. By Charles L. Parsons, R. B. Moore, S. C. Lind and O. C. Schaffer. Pp. 124, illus. Bull. 104, United States Bureau of Mines, Washington, D. C.

PETROLEUM AND NATURAL GAS RESOURCES OF CANADA. Vol. II. Description of Occurrences, Eastern and Western Canada. By Frederick G. Clapp and others. Pp. 404, illus. Canada Department of Mines, Mines Branch, Ottawa.

UEBER DEN EINFLUSS EINES SPAENEBRIKETTZUSATZES AUF DEN VERLAUF DES KUPOLOFENSCHMELZPROZESSES UND AUF DIE QUALITAET DES ERSCHMOLZENEN EISENS. By F. Wüst, in collaboration with F. Böcking and J. C. Stork. Reprinted from "Ferrum." 7¾x10½, pp. 122, illus., paper, 1 mark. Wilhelm Knapp, Halle, a. S.

TWENTY-FOURTH ANNUAL REPORT OF THE ONTARIO BUREAU OF MINES, Vol. XXIV, Part 1. Pp. 275, illus. Department of Lands, Forests and Mines, Toronto.

Contents: Statistical review; mining accidents; mines of Ontario; the Beatty-Munro gold area; the productive area of the Michipicoten iron ranges; the north short of Lake Huron; metallogenetic epochs in the pre-Cambrian of Ontario.

BRIEF COURSE IN METALLURGICAL ANALYSIS. By Henry Ziegel. 6½x9¾, pp. 72, $1. The Chemical Publishing Co., Easton, Penn.

This is an interleaved laboratory manual for the use of upperclassmen trained in elementary qualitative and quantitative analysis. It is supposed to cover 10 to 12 hr. work per week through two semesters. It fills its purpose well, but is not a necessity for the practicing chemist or metallurgist.

CIVIL ENGINEERING TYPES AND DEVICES. A Classified and Illustrated Index of Plant, Constructions, Machines, Materials, Means and Methods Adopted and in Use in Civil-Engineering Works of Every Class. By T. W. Barber. 5¼x8½, pp. 245, illus. D. Appleton & Co., New York.

The object aimed at in this work is the collection and classification in one handy volume of all the known devices and methods in use in every branch of engineering work, in the form of sketches, or brief drawings, or descriptions, sufficient to enable an engineer to make a selection without overloading the matter with detail that every competent engineer can readily design for himself. This is a unique and ambitious idea. As to the devices pictured, we are doubtful about there being "all," but certainly there are a good many. It is a handy and probably useful volume for the drafting room.

ENGINEERING GEOLOGY. By Heinrich Ries and Thomas L. Watson. Second Edition. 6x9 in., pp. 722, illus. $4. John Wiley & Sons, Inc., New York.

The second edition of this work, alone in its field, differs little from the first except in the addition of a chapter on historical geology. The book was originally prepared for the use of civil-engineering students, to acquaint them with the geological origin, structure, characteristics, etc., of the various materials with which they come in contact in their engineering work, such as the common rocks used for building-stone and road material, structure of rocks in relation to tunneling operations, dam and reservoir foundations, landslides, etc.; the geological conditions affecting and controlling underground water-supply; the relation of soil to sewage disposal and water purification, the occurrence and characteristics of fuels (coal, oils and gas), clays, cement, etc. Throughout the book it has been attempted to emphasize a practical application of the topics to engineering work. Although the book is intended primarily for civil engineers, certain parts contain more details than may seem necessary for the actual requirements of the civil engineer, but, on the other hand, there is a considerable amount of detail with reference to the materials of construction, including lime, cement and clays, which the mining engineer will appreciate.

The chapter on ore deposits is not particularly illuminating to the mining engineer, but is sufficiently comprehensive to be valuable for the civil engineer and will acquaint him, with as much detail as necessary to his profession, with the different types of ore deposits.

The most important change in the second edition is the addition of a lengthy chapter on historical geology. This chapter also is not likely to appeal to the student of geology, nor was it intended to, but acquaints the civil engineer with parts of paleontology and historical geology which he needs in his profession.

The book is profusely illustrated with halftones and diagrams, and each chapter is followed by a comprehensive list of references which have been consulted.

Although the book was prepared primarily for civil engineers, it contains much of valuable interest to the mining engineer, and renders easily available much material which would not otherwise ordinarily be accessible to the mining engineer without considerable research. A list of state geological surveys, a locality index and a subject index conclude the book.

This book should prove of the greatest value to those engineers whose problems bring them near to nature. The geological features that affect their problems are briefly and interestingly pointed out, and with the wealth of reference given, the work should be a most valued addition to the engineer's working library.

TEXTBOOK OF GEOLOGY. By Louis V. Pirsson and Charles Schuchert. 6x9, pp. 1,051, illus. $4. John Wiley & Sons, Inc., New York City.

The joint authors of this book are professors at Yale University. Part 1, by Professor Pirsson, devotes 243 pages to dynamical and 162 pages to structural geology. The book was prepared for a university textbook, and the aim of the authors to preserve a more even balance than usual in the treatment of the different subjects was accomplished. Except for this it follows the usual textbook style, dealing with weathering and erosion; ice and the ocean as geological agents; underground waters and organic life and its geological work; volcanoes, earthquakes and other crustal movements of the outer shell. Following the structure and properties of the earth's crust, sedimentary and igneous rocks are dealt with in a general way. Fractures, faulting and mountain building are succinctly treated. The chapter on ore deposits, which concludes the first part of the book, treats the subject in only a general way, well prepared, however, to give the groundwork for deeper study of the intricate study of ore deposits.

The second part of the book, consisting of 574 pages, on historical geology, by Professor Schuchert, treats the subject matter in very much greater detail. The amount of space devoted to historical geology is not as disproportionate as it at first seems, because the chapters on oceans, seas, etc., are not usually handled under this classification. The chapters on matter, organism, embryology and evolution, while fuller than in the ordinary geological textbook, are as brief as the rest of the historical work will permit. Chapters devoted to the origin and evolution of stars and the solar system, written by Joseph Barrell, although intensely interesting, are not particularly useful to the practicing miner or geologist, although they would not get anywhere else in the same space limit the valuable information given here, which is therefore ample justification for the inclusion. Then follows a most thorough description and discussion of the eras and periods of geologic time and members of the geologic column, and beginning with the Cambrian time, of the fossils pertaining to each. The beginning, evolution and development of animal and human life are most interestingly treated, although it goes into the matter in comprehensive detail. The first part of the book is typically a textbook, while the latter part approaches more the treatise; but it is a valuable book and is profusely illustrated with diagrams and photographs of structural and scenic details.

PERSONALS

D'Arcy Weatherbe, mining engineer, London, arrived Feb. 12 in New York.

Sydney H. Ball has returned to New York from a professional trip in Missouri.

W. C. Ralston, formerly of San Francisco, has opened an office at 25 Broad Street, New York.

Hector McInnes, Halifax, N. S., chief counsel of the Dominion Steel Corporation, has been elected a director of the company.

H. A. Morrison is opening up a new scheelite property near Sodaville, Nev., for Atkins, Kroll & Co., of San Francisco.

George T. Richards, mining engineer, of New York, has left for Fomento, Santa Clara, Cuba, on some engineering work.

Scott Turner, manager of the Arctic Coal Co., with properties in Spitzbergen, is in New York for a few days on business.

Norman B. Roper, superintendent of the Backus & Johnston Co., is returning to Peru after a six-months' vacation in the United States.

Henry Bruere has resigned his office as city chamberlain of New York, to take effect May 1, and will then take a position with the American Metal Co., New York.

H. H. Stoek, head of the department of mining engineering in the University of Illinois, has been appointed a member of the Illinois Mining Investigation Commission.

Leonard Howard Willett, who claims to be an expert metallurgist, was taken in charge at Salt Lake City, Utah, recently, and held for examination as to his sanity.

Adolph Ballanberg, a Michigan College of Mines man, has taken a position as engineer in charge of the Porcupine Exploration Works in the Porcupine District of Michigan.

John Williams, assistant general foreman of blast furnaces at South Works, Illinois Steel Co., has been appointed general foreman of blast furnaces at the works of the Minnesota Steel Co., at Duluth.

A. N. Diehl, assistant general superintendent, Duquesne steel works and blast furnaces of the Carnegie Steel Co., at Duquesne, has been elected chairman of the metallurgical and mining section of the Engineers' Society of Western Pennsylvania.

E. H. Jones, for several years construction engineer in charge of the building of the new smelting works of the Arizona Copper Co. at Clifton, Ariz., has resigned and has gone to Ontario, Canada, where he will be consulting engineer for an important mining company.

Charles T. Carnahan, a well-known mining man, who went from Cadiz, Ohio, to Colorado more than 30 years ago, and is well known to old Leadvillians and Denver folk, recently took up his residence in New York. Not long ago he paid a visit to William H. Brinckerhoff, an old friend in Cadiz, partly with the purpose of seeing Miss Marie B. Brinckerhoff, who was one year old when Mr. Carnahan left Cadiz. Mr. Carnahan fell in love with her at once, and on Feb. 14 they were married.

OBITUARY

Thomas Clark Noyes died at St. Louis, Mo., Feb. 2, aged 42 years. He was born in Butte, Mont., graduated from the University of Michigan, and for 18 years had devoted himself to exploration and mining in Alaska, where he became one of the well known men of that territory. He leaves a widow and one daughter.

Oliver Daunais, a pioneer mining man of the Lake of the Woods district, Ontario, died at Kenora Feb. 5, at the age of 80 years. He started prospecting about 1879 in the Port Arthur district, and discovered several silver mines, and at one time was the owner of the Silver Mountain, Beaver and Rabbit Mountain properties, on which he realized about $350,000. He went to the Lake of the Woods region about 1894 and was successful in securing several promising gold claims. He leaves a widow, four daughters and three sons.

Dr. C. Willard Hayes died in Washington, Feb. 8, aged 57 years. He had been for 10 years Chief Geologist of the U. S. Geological Survey, leaving that position four years ago to become vice-president and general manager of the Mexican Aguila Oil Co. In that position he had charge of all the Cowdray-Murray oil explorations in Mexico as chief geologist. He had a high reputation as a scientific man, being numbered among the leading economic geologists of the world. Doctor Hayes was born in Granville, Ohio, and was educated at Oberlin College and Johns Hopkins University. In 1883 he became Principal of the Brecksville, Ohio, High School, and in 1887 received his appointment to the Geological Survey as assistant geologist, becoming Chief Geologist in 1902. During 1898-9 he was geologist to the Nicaraguan Canal Commission. Doctor Hayes was a member of the Geological Society of America, the American Institute of Mining Engineers, the Mining and Metallurgical Society of America, and a number of other scientific societies. He was the author of numerous articles on theoretic and economic geology in various publications and of many official reports.

SOCIETIES

Teknik Club of Denver—This club held its regular dinner meeting at the Shirley Hotel, Feb. 8. About 40 members were present. The paper of the evening was presented by Mr. Eggers, of the Mine and Smelter Supply Co., who discussed the development of ball mills and submitted the results of recent types of mills. The club intends to conduct a course of scientific lectures each year. Eminent speakers will be secured and subjects of general scientific interest will be presented.

Colorado School of Mines—A department of research was established by the board of trustees on Jan. 13. The new department will be under the direction of President Phillips. Prof. J. C. Bailar, of the department of chemistry, and Prof. E. J. Dittus, of the department of metallurgy, have been transferred to the new department. All research work that goes on at the school and all publications regarding research work and tests will be credited to the new department. The department has already received many samples of ore from the State Bureau of Mines.

American Institute of Mining Engineers—On Feb. 4, the Montana Chapter held its annual session at the Silver Bow Club in Butte. Following an informal dinner, the business session was devoted to the election of officers for the ensuing year. J. L. Bruce was elected chairman; W. C. Siderfin, vice-chairman; N. B. Brawley and W. T. Burns, directors; M. H. Gidel, secretary and treasurer. D. C. Bard and Chester Steele presented a paper entitled: "Present Status of Oil and Gas Prospecting in Montana." This was followed by a brief description by Mr. Frederick Laist, of the experimental zinc plant now in successful operation at the Washoe works in Anaconda. About 50 members were present.

TRADE CATALOGS

The Scranton Pump Co., Scranton, Penn. Bulletin No. 106, Triplex Plunger Pumps. Illustrated, 8 pp., 6x9 in.

Wheeler Condenser and Engineering Co., Carteret, N. J. Bulletin 108-A, Centrifugal Pumps. Illustrated, 34 pp., 6x9 in.

The Denver Rock Drill Mfg. Co., Denver, Colo. Bulletin No. 60, Model 60 Denver "Dreadnaught" Drifting Drill. Illustrated, 16 pp., 6x9 in.

Atkins Filter Press Corp., 165 Broadway, New York. Catalog, Centrifugal Filter Presses and Pressure Filters. Illustrated, 20 pp., 7x10 in.

Taylor-Wharton Iron and Steel Co., High Bridge, N. J. Bulletin No. 117, "Tisco" Steam Shovel and Dredge Parts. Illustrated, 32 pp., 6x9 in.

Bausch & Lomb Optical Co., Rochester, N. Y. Catalog Optical Instruments for Inspection and Testing of Materials. Illustrated, 36 pp., 6½x10 in.

The Brown Hoisting Machinery Co., Cleveland, Ohio. Catalog D, Brownhoist Tramrail Systems, Trolleys, Electric Hoists. Illustrated, 64 pp., 6x9 in.

John A. Roebling's Sons Co., of Trenton, N. J., has begun issuing a house organ, "Roebling Wire Rope," which will be of interest to users of the Roebling products.

The Denver Engineering Works Co., Denver, Colo. Bulletin No. 1076, Ball Mills. Illustrated, 8 pp., 8½x11½ in. Bulletin No. 1075, Richards Improved Pulsator Jig. Illustrated, 8 pp., 8½x11½ in.

INDUSTRIAL NEWS

The Terry Steam Turbine Co. announces the appointment of Maynard D. Church as chief engineer.

The Lenher Engineering Co., sales agent for the S. Flory Manufacturing Co., hoists and Cableways, announces that its office is now located at 95 Liberty St., New York City.

The A. Lietz Co., makers of surveying and nautical instruments, has moved its main office and sales room from its factory at 632 Commercial St. to the Mechanic's Institute Building, 61 Post St., San Francisco, Calif.

The Bacharach Industrial Instrument Co., Pittsburgh, Penn., is putting a pocket CO_2 indicator on the market, which will give results in about 2½ min. One filling of the apparatus suffices for about 200 determinations.

The Bonnot Co., of Canton, Ohio, has been awarded a contract for 12 ball mills, 8 ft. in diameter, for the Alaska Juneau Mining Co. The mills will be built extra-heavy throughout with a view of reducing maintenance to a minimum.

E. C. Waldvogel, who has been connected with the Yale & Towne Manufacturing Co. for the last 11 years, and who has successively filled the positions of traveling salesman, sales manager and assistant general manager, has just been appointed general manager.

Hamilton, Beauchamp & Woodworth, Inc., is now ready to run tonnage tests in its experimental metallurgical laboratory at 419, the Embarcadero, San Francisco, Calif. The equipment includes a 10-ton Minerals Separation machine, a 10-ton Callow cell, breakers, a Hendy ball mill, a Hendy tube mill, Dorr classifier, and a Deister Concentrator Co. slime and sand table.

The Anaconda Copper Mining Co. has placed an order for six more 10-ft. diam. by 4-ft. cylindrical length Hardinge ball-pebble mills, making a total of 56 conical mills for its new plant, of which 48 are already in operation. The Hardinge company reports that the 10-ft. mills are direct-connected herringbone-gear-driven, operating with less than 75% of the power which was originally estimated to be necessary.

The Eastern Pennsylvania Power Co., a W. S. Barstow & Co. property, located at Dover, N. J., on Dec. 31 closed a contract with the International High Speed Co. to supply current for a 1,200-kilowatt Heroult-type electric furnace which the latter company is to operate at Rockaway, N. J. The furnace has a capacity for treating 50 tons of steel per day from an openhearth furnace. The steel plant is 10 mi. from the power station at Boonton, from which current is supplied at 33,000 volts, three-phase.

Recognizing that practically everyone is certain that high speed, better work and greater human efficiency are possible in a stable as compared with a vibrating building, but that exact data proving this fact are difficult to obtain, the Aberthaw Construction Co., of Boston, Mass., is undertaking an exhaustive investigation in the effort to bring together conclusive evidence. It will greatly appreciate any suggestions or reports of experience that our readers may be able to send to them. These may have to do with any aspect of the case that will assist in the collection of facts or the reaching of conclusions.

The Apollo Electric Steel Co. has been organized for the purpose of putting on the market high-grade steel in the shape of billets, bars and specialty products. The new company will be incorporated with a capital stock of $500,000 of which $400,000 will be issued at this time. Of this amount $230,000 has already been subscribed. A site of about 8½ acres has been secured at Apollo, Armstrong County, Penn., and contract has already been let for suitable buildings. The furnaces will have a basic lining, and have a daily output capacity of 100 net tons each per day of 24 hr., or a combined capacity of 200 tons per day.

The United Smelting and Aluminum Co. has been incorporated with a full-paid capital of $175,000. Its new plant at New Haven is said to be insufficient to take care of its growing business, and the company has purchased a tract of land 80x114 ft. adjoining its present buildings and will commence building operations on an addition immediately. In it four or five reverberatory furnaces will be installed for melting aluminum, increasing the company's output two-fold, while a white metal department will be equipped. In addition to all grades of aluminum ingots, alloys and granulated aluminum, formerly manufactured by the company, babbitt metals, spelter, lead and other metals will be turned out. The firm of Abe Lapides, former owner of the United Smelting and Aluminum Co. has been absorbed by the new corporation.

NEW PATENTS

United States patent specifications listed below may be obtained from "The Engineering and Mining Journal" at 25c. each. British patents are supplied at 40c. each.

ANNEALING FURNACE—Combined Annealing and Muffle Furnace. Alexander Kinnear, Toledo, Ohio. (U. S. No. 1,170,164; Feb. 1, 1916.)

BELT ELEVATOR. George M. Wolff, Milwaukee, Wis. (U. S. No. 1,167,869; Jan. 11, 1916.)

BISMUTH—Method of Treating Impure Bismuth Metal. Walter C. Smith, Chrome, N. J., assignor to United States Metals Refining Co., Chrome, N. J. (U. S. Uo. 1,166,721; Jan. 4, 1916).

CONCENTRATION—Combined Concentrating and Amalgamating Machine. Warren L. McLean, San Francisco, Calif., assignor of one-half to John A. Van Beal, San Francisco, Calif. (U. S. No. 1,169,083; Jan. 18, 1916.)

CONCENTRATOR. John F. Isbell, Los Angeles, Calif., assignor to Orren Allen, Denver, Colo. (U. S. No. 1.169,959; Feb. 1, 1916.)

COPPER ALLOY. William C. Pease, Marietta, Ohio. (U. S. No. 1,168,962; Jan. 18, 1916.)

DESULPHURIZING and Smelting Ores. Arthur S. Dwight, New York, N. Y. (U. S. No. 1,169,069; Jan. 18, 1916.)

DRILLS—Improvements in or relating to Chucks for Rock Drills. J. C. Vaught, Johannesburg, Transvaal. (Brit. No. 21,405 of 1914.)

ELECTRIC FURNACE—Process of Obtaining Metals, Such as Lead or Zinc, in an Electric Furnace. Alois Helfenstein, Vienna, Austria-Hungary. (U. S. No. 1,167,998; Jan. 11, 1916.)

ELECTROCHEMISTRY—Ore-Reducing Process. Leon St. D. Roylance, San Francisco, Calif. (U. S. No. 1,168,678; Jan. 18, 1916.)

EXCAVATOR—Cable Excavator. Alvah D. Hadsel, Philadelphia, Penn., assignor to Cable Excavator Co., Philadelphia, Penn. (U. S. No. 1,170,484; Feb. 1, 1916.)

FURNACE—Metallurgical Furnace. Utley Wedge, Ardmore, Penn. (U. S. No. 1,170,376; Feb. 1, 1916.)

GAS WASHING—Method of and Apparatus for Gas-Washing. Herman A. Brassert, Chicago, Ill. (U. S. Nos. 1,169,764; 1,169,765; and 1,169,766; Feb. 1, 1916.)

LAUNDER CLASSIFIER. Gordon Land, Seattle, Wash., assignor to Leighton Howard Smith, Seattle, Wash. (U. S. No. 1,170,286; Feb. 1, 1916.)

LEAD SULPHATE—Process of Preparing Lead Sulphate. Alexander S. Ramage, Buffalo, N. Y., assignor to International Color & Chemical Co., Inc., Detroit, Mich. (U. S. No. 1,168,413; Jan. 18, 1916.)

MINE CARS—Safety Apparatus for Mine-Cars and the Like. Howard Houseknecht, Freeland, Penn. (U. S. No. 1,170,263; Feb. 1, 1916.)

NATURAL GAS—Method of Locating Natural Gas. Frederick Squires, McConnelsville, Ohio, assignor to Walter Squires, Zanesville, Ohio. (U. S. No. 1,168,757; Jan. 18, 1916.)

ORE TREATMENT—Treating Ores. Utley Wedge, Ardmore, Penn. (U. S. No. 1,170,375; Feb. 1, 1916.)

PHOSPHORUS—Blast-Furnace Process of Producing Phosphorus and Phosphorus Compounds. John J. Gray, Jr., Rockdale, Tenn. (U. S. No. 1,168,495; Jan. 18, 1916.)

REGENERATIVE FURNACE. John E. Bell, New York, N. Y. (U. S. No. 1,170,397; Feb. 1, 1916.)

REGENERATIVE FURNACES—Valve Mechanism for Regenerative Furnaces. Louis N. McDonald, Youngstown, Ohio. (U. S. No. 1,170,301; Feb. 1, 1916.)

RETORTS—Ore Charges for Retorts and Method of Treating the Same. Charles A. H. de Saulles, New York, N. Y. (U. S. No. 1,166,447; Jan. 4, 1916.)

ROASTING—Improvements in or Relating to Mechanical Ore-Roasting Furnaces. J. Harris, Darnall, England. (Brit. No. 22,688 of 1914.)

SEPARATION—Method of and Apparatus for Separating Solids From Gas. Ray C. Newhouse, Milwaukee, Wis., assignor to Allis-Chalmers Manufacturing Co., Milwaukee, Wis. (U. S. No. 1,168,543; Jan. 18, 1916.)

SMELTING of Ores and Apparatus Therefor. Frank William Highfield, Caversham, England. (U. S. No. 1,167,176; Jan. 4, 1916.)

SMOKE—Method and Means for Indicating Suspended Matter in Gases. Walter A. Schmidt, Los Angeles, Calif., assignor to International Precipitation Co., Los Angeles, Calif. (U. S. No. 1,168,227; Jan. 11, 1916.)

STEEL—Improved Process of the Heat Treatment of Steel. Gio-Ansaldo & Co., Genoa, Italy. (Brit. No. 18,387 of 1914.)

SULPHUR DIOXIDES—Process for Recovering Sulphur Dioxide. Lucien Paul Basset, Montmorency, France. (U. S. No. 1,168,046; Jan. 11, 1916.)

TIMBER—Art of Impregnating Timber and Other Porous Material with a Preservative. Oliver P. M. Goss, Seattle, Wash. (U. S. No. 1,167,492; Jan. 11, 1916.)

TITANIC OXIDE—Method of Obtaining Titanic Oxide and the Resulting Product. Auguste J. Rossi and Louis E. Barton, Niagara Falls, N. Y., assignor to The Titanium Alloy Manufacturing Co., New York, N. Y. (U. S. No. 1,166,547; Jan. 4, 1916.)

VANADIUM, URANIUM, ETC.—Process of Extracting Vanadium, Uranium and Radium from Ores. Richard Bishop Moore, Denver, Colo. (U. S. Nos. 1,165,692 and 693; Dec. 28, 1915.)

ZINC OXIDE—Improvements in or relating to the Treatment of Volatilized Zinc Oxide and the like. F. W. Highfield Caversham, England. (Brit. No. 6,222 of 1914.)

Editorial Correspondence

SAN FRANCISCO—Feb. 15

(By Telegraph.)

Hetty Green's Old Eureka Mine has been acquired by Arthur Beam, of Denver, and others said to represent the United States Steel Corporation. Price stated as $600,000.

SAN FRANCISCO—Feb. 8

Chief Mine Inspector Edwin Higgins has issued an open letter to mine operators and miners urging coöperation of both employers and employees with the mine safety department of the California Industrial Accident Commission. The former chief inspector, H. M. Wolfin, spent about two years investigating the mines and laying the foundation for the mine-safety rules, through coöperation with the United States Bureau of Mines and the California Metal Producers' Association. He also secured coöperation of miners and operators and others prominent in the mining industry.

The San Francisco Mint contained more coin and bullion at the close of business on Jan. 31, 1916, than at any other time in its history. The total value, $365,017,927.87. The gold received from foreign sources has decreased from $8,286,851 in November to $3,595,042 in December, and at the end of January these receipts had decreased to $717,138. Gold coin and bullion from all sources received in January totaled $4,576,584, as compared with $7,433,020 in December and $12,-613,463 in November. Shipments of gold from Japan almost ceased in November and the Australian shipments declined approximately $5,000,000 from November to December.

Placer Scheelite production in Atolia district is increasing. There are now 30 float diggers, the number increasing from a half dozen in October. One section known as the "potato patch" is producing an average of 300 lb. of high-grade scheelite per day, and about a ton of lowgrade. The workmen, mostly foreigners, are paid $3 per day of eight hours. In the Stringer district both quartz and placer scheelite are produced and about 100 men are employed, most of whom are leasers who pay as high as $1 per ft. for ground averaging 250 ft. of surface. The mineral is of small size, but has good quality as that of the "potato patch." Recent discovery by Robert Tate between Atolia and Randsburg indicate that area of tungsten belt in Randsburg district is about 6 mi. long and 3 mi. wide.

The Proposed Merger of the Union Oil Co. into the Pan-American Petroleum and Transport Co. seems to depend as much upon Andrew Weir as upon the so-called majority stockholders. And for that reason the merger may not be consummated, as Weir is reported to have made it plain that he is opposed to participation by the Union. Weir owns jointly with R. Tilden Smith, of London, $2,779,300 of Union stock. This stock is said to have been obtained when outstanding acceptances, given by the Union to Weir and his associates, were cancelled as a result of the failure of Englishmen to take over the control of the company. It is stated at Los Angeles that one of the main conditions of the option upon the Union stock given by the Stewarts to Mark L. Requa, was that the option would not be effective without Weir's consent.

DENVER—Feb. 10

The Federal Bureau of Mines district headquarters will be removed from Denver to the Colorado School of Mines at Golden. The removal was ordered Jan. 28 by Secretary of the Interior Lane and will take place some time during the spring. The change is in accordance with the policy of the national government in extending its mine bureau work to coöperate with mining schools throughout the country. The bureau will be situated in the hall of engineering of the School of Mines, and the department of physics now occupying this building will be removed to new quarters in the hall of chemistry. During the past three years the bureau has been domiciled in the Foster building in Denver. The Denver bureau has been one of the most important stations in the United States and exhaustive experiments have been made leading toward the perfection of methods of reducing the rare metals. Special attention has been given to radium and a new and successful method of concentrating radium ores has been devised which lowers the cost of extracting and refining this element. Work has also been done on molybdenum; the metallurgy of tungsten will next be taken up. The work has been under the direction of Dr. R. B. Moore, who has an efficient staff of 10 assistants. The staff to be maintained at Golden will be larger than that of any other mining bureau in the United States with the exception of Washington and Pittsburg.

SALT LAKE CITY—Feb. 11

The Notification of the 25c. Wage Increase by the Silver King Coalition of Park City states that when the price of lead drops below $5 and the price of silver under 55c., the scale of wages will be reduced to the old standard, but should the price of lead remain above $6 and the price of silver advance to 65c. or above, those employees working underground will receive a further increase.

The Net Proceeds of the Utah Copper for the year 1915 were $13,741,480, as shown by the report of the State Board of Equalization for purposes of taxation. The total gross returns were $27,155,943, and the costs $13,414,463. There is a large proportionate increase in net proceeds over 1914, on account of higher metal prices. The company's taxes this year are not expected to be any larger than last under the new system of full valuation and reduction in the rate of taxation. In the past, according to the State Board of Equalization, the company has been assessed at full value. The company has received a refund in taxes on several occasions.

NEW YORK—Feb. 15

A Sale of Nichols Copper Co. common was recorded a few days ago; 50 shares at $52 each.

MORENCI—ARIZ.—Feb. 9

The Clifton-Morenci-Metcalf District is producing copper at about two-thirds of rate at which it was producing when the strike was called, Sept. 11, 1915. The only reason the full rate of production has not been reached is the concentrating plants are not able to handle the ore. Although there is a considerable quantity of water in various lower workings, it is not so situated as to interfere with the haulage or with the working of the larger producing stopes. The mines could easily give the mills a full run. All strikers and non-strikers, both here and at Duncan, have been put to work and some new men are being taken on. The men seem to work harmoniously together; there have been no breaches of peace. The spirit of the Western Federation is fast waning; Governor Hunt admits that the organization has no practical footing in the state. The Duncan tent houses are being taken down and removed. The Detroit Copper Co.'s mill is taking about 1,000 tons daily as compared to 1,600 at the beginning of the strike. The Ryerson mine is producing something like its former tonnage, it having taken but two or three days to bail the water out. The Old Yankee mine still has several thousand feet of tunnel work and two or three small stopes under water. Its best producer, however, 16 Stope, was always high and dry. Copper Mountain was not bothered with much water, but Arizona Central is drowned out, but is not heavy producer, however. The Arizona Copper Co. was not materially hindered by accumulation of water. Its main haulageway is above all water trouble and below all producing places. Every effort is being made to get the mill back to three shifts a day. The Morenci Southern Ry. is now running two trains daily between Morenci and Guthrie. Every train going out is carrying carloads of copper bars.

IRONTON, MINN.—Feb. 9

Despite the First Successful Struggles against cold weather noted on page 215 of the Journal, Jan. 29, the Hillcrest stripping operations had to suspend finally from difficulties due to sub-zero weather, the worst in Minnesota for many years. A high wind blowing directly in the face of the nozzle stream prevented the water from reaching the bank in a sufficient quantity to keep the sand pump going to capacity. The discharge finally froze until there was barely a 6-in. opening in the 12-in. pipe line. The operators had the double satisfaction, however, of knowing that they had accomplished practically all of the work they intended doing this winter, and that almost every stripping job on the Cuyuna or Mesabi Ranges, as well as many underground operations, was closed down by the same severe conditions.

DULUTH, MINN.—Feb. 11

All of the Iron Mining Companies in Minnesota are getting ready for a greatly increased output during the 1916 season. Inasmuch as almost 47,000,000 tons were shipped in 1915, and inasmuch as it seems to be pretty generally conceded that about only 57,000,000 tons can be handled on the Lakes during the coming summer, it is difficult to see what is going to become of the big increases in tonnage that have been called for from the different mines, which increases amount to a great deal more than the 10,000,000 additional tons which the lake boats can handle. There is no question but what the iron mining district is in for a real boom, and will ship all that the vessels can carry; but owing to the limited tonnage of the latter, it is a fair question to ask if the mines are not a trifle overestimating in their optimistic production prognostication.

HOUGHTON, MICH.—Feb. 12

In the Porcupine District, further south than the White Pine, exploration work, on a larger scale than ever before planned, now is going on. The most important of this work is that being conducted at the White Pine Extension property. The force there consists of 75 men. This number will be increased early in the spring to 200 if present plans carry. The diamond drill operations show better looking copper than any previously shown here. The formation is different from any other opened in this district, in that it contains fine particles of copper and no bunches of mass copper. The richest of the copper is found in the shale itself, 200 lb. average being not unusual. The formation is persistent for a distance of 3½ mi., with holes down at various depths every 250 ft.

There Are Two Other Exploration Companies operating in this district. The White Pine Extension work is in charge of the Smith-Stanton interests. At the territory of the Porcupine Exploration, 4 mi. west of the White Pine Extension, camps are built and a road cut through the wilderness. This Porcupine Exploration district is being opened by Nathan F. Leopold, of Chicago, and Fred Close, who is consulting engineer of the White Pine Extension and directing work at other points in this section. One drill will be in operation next week and two more within 30 days. Forty men are on the job.

On an Extensive Tract, east of the White Pine Extension, explorations are being conducted for an unnamed company financed by Angus Smith of Detroit, Thomas F. Cole of Duluth, the Stanton interests of New York, and Mr. Close. Three drills now are operating.

JOPLIN, MO.—Feb. 12

The Mill Construction Planned and under way in the Joplin district is the greatest known unless periods of 1898-99 and 1905-06 equal it. Certainly the activity along this line is staggering and it is doubtful if all of this mill construction is based upon anything like a sound basis considered from a purely economic standpoint. Taking only the reports of the past week there were no less than 22 plants either started, or plans made for their early erection. They ranged in capacity from 50 to 600 tons. While some of these plans may never materialize, the spirit of the district makes pretty certain that they will. Scrutiny of the plans so far as made public would seem to indicate that the smaller tonnage plants which apparently predominate in numbers are being built as emergency and temporary plants. They are designed to take care of the ore mined upon a short-lived mine or during such time as the ground proves profitable. Operators of this class are taking as small chances as possible to be caught with a costly plant upon their hands when the mine becomes exhausted or should ore prices take a severe drop from present levels. Another characteristic of these plants is that nearly without exception they are being put up by practical men with long experience in the field.

Another Class of Mills comprises the large plants designed for the best practice now known. They are being placed upon known low-grade deposits not only looking to immediate profits from high prices now prevailing, but evidently with a view to operation when lower-price levels obtain. On the other hand, there are mills of this class being planned for properties whose possibilities depend wholly upon the present price level being continued for some time to come. While they may succeed, their plan of operation is founded upon a speculative basis and investors should be very careful in seeing that they have the correct facts to determine whether they are investing in zinc mining or merely speculating in it. There have been evidences recently of projected stock deals which bode no good either for the investor or the legitimate zinc industry of the district. Until recently there has been an absence of this sort of stock sales in the face of the boom conditions prevailing that has been really astonishing, considering how it has previously flourished in every mining center of the United States. It is returning to the Joplin district as well as to other flourishing mining districts of America and legitimate industry must help guard its good name. In the Joplin field the public organizations, such as commercial clubs of the various cities, mining organizations, mining engineers, and the most influential newspapers have already given out warnings to be careful and are holding themselves ready to assist the investor in keeping out of bad investments.

Still Another Class of Mills returning to favor on account of the activity of small operators is the old-time custom mill. A number of such plants have been erected this year and plans are being made for others. Although there have been these additions to the milling capacity there is still room for a few of this class of mills at several points in camps where shallow ore deposits are being worked. This mill building activity has, however, been terribly handicapped for a period of three weeks due to the weather conditions that have prevailed. Each week has seen just a little worse condition brought about until it appears almost impossible to deliver either lumber or machinery in many camps. It has been a good many years since the roads of this district have been so nearly impassable and so far there is no relief from the weather.

JUNEAU, ALASKA—Jan. 27

The Juneau District Was Visited on Wednesday, Jan. 19, by an almost unparalleled blizzard which practically paralyzed mining and business of all kinds for several days. At the height of the storm, mercury reached 20 deg. below zero, accompanied by a 75-mi. wind. The Alaska Juneau mill was closed down for two or three shifts on account of the cold. The Salmon Creek power line to the Perseverance mine was blown down and as a result the Perseverance mine was idle for three days. The Treadwell escaped, with the exception of a few frozen steam-pipes. The diamond drillers at the Alaska Gold Belt were forced to discontinue their work and fight the storm to keep alive. Over the mouth of the Alaska Gold Belt tunnel 30 ft. of snow has drifted, and must be shoveled away before drilling operations can be resumed.

TORONTO—Feb. 8

Gold Placer Mining is being undertaken near D'Arcy, Sask., on the Goose Lake line of the Canadian Northern Ry., 98 mi. from Saskatoon. Nuggets are reported found in the bed of an old stream by Ralph Proven and others of Saskatoon and about 50 claims had been taken up at last report. There is a plentiful supply of water and active work will be started early in the spring.

At a Meeting Held Here Feb. 7 the shareholders of the Consolidated Mining and Smelting Co. of Canada ratified the purchase of the common stock of the West Kootenay Light and Power Co., amounting to $2,000,000. The basis of the transaction is an exchange of $75 par value of Mining and Smelting stock for $100 par value of West Kootenay. This will give the Smelting company control of the power company.

That a Nickel-Refining Plant would shortly be established in Canada was officially confirmed yesterday when Premier Borden laid before the Canadian Parliament correspondence between the government and President Ambrose Monell, of the International Nickel Co. On Dec. 29 the Premier wrote to Mr. Monell, pointing out that since the outbreak of the war there had been a strong feeling in Canada for the establishment of a nickel refinery, sufficient at least to supply all the requirements of the British Empire under any conditions and asking the company's consideration of the matter as soon as possible. Mr. Monell, under date of Jan. 7, replied as follows: "We will grant your request and erect in the Dominion of Canada, at such point as seems in our judgment to be the most economical for operation, a plant for the refining of nickel, of such initial capacity as will secure to Great Britain and Canada within themselves a product of refined nickel to the extent of their requirements." He added that as soon as the weather permitted the selection of a suitable site would be undertaken, which in the opinion of the company would be somewhere on the Canadian Atlantic seaboard, Premier Borden on Jan. 10 wrote expressing his satisfaction and the hope that the initial capacity of the plant would be sufficient not only to supply the possible requirements of Great Britain and Canada, but of the whole empire. In answer to this the company pointed out that the consumption of nickel in the British Empire outside of Great Britain and Canada was insignificant, and that the refinery will be designed in units so that additions can be made as future requirements may determine. While the conclusion reached by the negotiations is generally regarded as satisfactory, it is criticised by extreme protectionists as not going far enough, in the direction of compelling the refining of all the nickel ore produced in Canada and controlling the entire output in the interests of the empire. There is a strong feeling in some quarters in favor of an export duty on nickel ore or matte, and strict government supervision in connection with the industry, which will probably find expression during Parliament.

The Mining News

ALASKA

THE COLDEST WEATHER on record in Valdez district has interfered with mining in the field to a large extent. Granby operations have closed for the winter as well as mine of the Ramsay Rutherford Gold Mining Co. Granite mine at Port Wells continues to work despite the cold. New wharf at the Fidalgo Bay landing of Alaska Mines Corporation, under the management of E. D. Reiter, was partly destroyed by wind, when it was practically finished. Will be rebuilt at once. Piledriver was lost in 32 ft. of water but later recovered. Damage was also done Ellamar Mining Co.'s docks at Ellamar.

MT. ANDREW MINE (Ketchikan District)—W. J. Rodgers started up mine for the year on Feb. 1. Contemplates big work and will add equipment in spring.

HAZELET DEVELOPMENT CO. (Valdez)—Organized with capital stock, $1,000,000. Incorporators, John A. Hazelet, Effie M. Hazelet, John Lyons, all of Valdez.

COLD BAY (Near Unga)—Coarse gold has been struck at Cold Bay and rush is looked for. The "Dora" recently brought 30 oz. of the newly discovered pay dust to Seward, which attracted much attention.

VALDEZ AND SEWARD were visited by destructive fires during the unusual cold snap in the latter part of January; $15,000 worth of buildings were destroyed in Valdez, while docks at Seward were destroyed with a loss of $50,000.

M. J. O'CONNOR (Douglas)—Announces that eastern capitalists have become interested in Jersey City group of claims on Douglas Island, close to Treadwell workings, and that development will start in spring. He is not ready to announce names of those interested at present.

CHICHAGOFF MINE (Chichagoff)—Mill closed down for a short time on account water shortage due to extreme cold. Flotation plant will be installed under direction of Minerals Separation Co. Graphite in the ore has long been a problem when cyanidation was considered and it is hoped by Manager James Freeburn that this will be eliminated by the new process.

JAP PROPERTY—(Seward)—Acting for syndicate of Minnesota capitalists, Dr. H. O. Schalaben, of Seward, has just purchased the group of eleven quartz claims in the Willow Creek district, known as the "Jap property." Claims are in same locality as well-known Alaska Free Gold, Gold Bullion and Independence mines. Development work will commence as soon as climatic conditions permit.

ARIZONA

Cochise County

SHATTUCK ARIZONA (Bisbee) — Production for 1915: 11,154,211 lb. copper; 3,151 oz. gold; 201,869 oz. silver; 2,345,342 lb. lead; copper recovered, 117.92 lb. per dry ton ore; lead recovered, 300.67 lb. per dry ton ore. Cost per pound refined copper, 8.446c.; sold at 18.5c. average gross price. Development work for year, 14,978 ft.; development work from beginning to close of year, 90,240 ft. Out of net profit of $1,174,028, stockholders were paid four regular dividends and one extra dividend, totaling $875,000. Total net surplus at end of year, $897,679.

Graham County

LAUREL CANYON (Klondyke)—New concentrator at Grand Reef mine now in operation; expected to be running shortly at full capacity, 200 tons per day. Company has about 600,000 tons blocked out; runs $18 in silver and lead, also carries copper values. Thirty-five men are now employed. Max Bauersfield has been awarded contract for hauling concentrates to Fairview, from which point they will be shipped to El Paso smelter.

Mohave County

MERRITT (Oatman)—Group of 3 claims and 2 fractions adjoining United Eastern, Tom Reed and Big Jim mines has been acquired by Charles S. Sprague, president and manager of Jumbo Extension Mining Co., Goldfield, Nev., from J. E. Leeper, of Kingman.

UNITED EASTERN (Oatman)—It has been officially announced that negotiations looking to merging of United Eastern and Tom Reed mines have been abandoned without success. Long considered 200-ton mill will now be erected with all possible dispatch.

MOTHER LODE (Kingman)—New organization of J. E. Leeper, of Kingman, and associates, W. C. Miller, of Jerome; T. E. Pollock, of Flagstaff; J. C. Callaghan, of Phoenix; Joseph M. Muheim, of Bisbee, and I. M. George, Kingman. Company will develop Roadside mine in Union Pass section, 24 mi. west of Kingman. One hundred-foot shaft exposes 50-ft. vein averaging $9 per ton; shaft will be deepened to 500-ft. point.

Pima County

NEW CORNELIA (Cornelia)—Contract for depot of Tucson, Gila Bend & Cornelia railroad, has been let. Work is being pushed on railroad yards and new buildings. Over 2,000 tons of steel is being loaded at C. & A. smeltery, at Douglas, which will be shipped to Cornelia and used in construction of railroad shops and warehouses. Crushing plant used at experimental mill is being moved to new mill site and will be used to crush rock for concrete.

Pinal County

COPPER CHIEF (Casa Grande)—Manager John E. Reade reports high-grade silver strike, also important find of gold ore.

Yavapai County

RECENT FLOODS uncovered 2-ft. vein of rich ore carrying native copper in Copper Basin.

WICHITA PLACER (Prescott)—Hydraulic giant recently installed is handling 15 cu.yd. earth per day, with recoveries better than was expected. Ground is handled right down to bedrock; much coarse gold is taken from crevices in rock.

RUTH (Prescott)—Two carloads of 41% zinc concentrate and 1 carload of concentrate running high in gold, silver and lead were results of week's run at new mill. Recovery is so satisfactory that large amount of development work will be undertaken soon.

BIG PINE MINING (Senator)—Has purchased 100-ton cyanide plant of the Mascot mine, at Crown King, and will move it to Senator soon as weather conditions will permit. Company is reported to have 70,000 tons of $10 ore blocked out. Will have water power sufficient to run mill 5 months in the year; steam plant will be used in dry weather.

CALIFORNIA

Calaveras County

GRAVEL MINING is more active than for several years. Brewster and What Cheer, in Chili Gulch, are in operation and employing a large aggregate crew. Rough Diamond, Safe Deposit, Veigh, Curnow, Emerson, all on what is known as Blue Ledge, are being operated or developed. Also Stockton Ridge and Nuner are getting good gravel. Old El Encino, near the Junction, has been bonded and work begun on Coffee Mill. Bad weather making bad roads has hampered industry, but as there is now plenty of water, operation will go on actively as soon as weather clears. Also American Camp district is being revived.

SOUTH CAROLINA (Angels Camp)—Reported that large bodies of good ore are blocked out and the ore bins and chutes are filled. The mill will be started immediately. Mine idle since last August on account of ground slides.

CALAVERAS COPPER (Copperopolis)—Flotation process installed and working successfully. It is stated recovery is 90%, which is much greater saving than when concentration was only method. Crushing plant is being modernized and new mill of 250 tons capacity is being installed. About 100 men are on payroll of company. Coffer and Trask are working in several places under lease and employing 35 men.

SUMMERVILLE (San Andreas)—New mining company formed to develop and operate Thorp mine, 5 mi. south. Property idle 18 years, although reported to have produced rich ore in early days. Company authorized to issue 200,000 shares in payment to Frank A. Summerville for 450 acres and a patented mining claim and 1,331 preferred shares and 2,994 common shares for expenditures and services. Remainder of stock may be sold to the public.

Colusa County

PROSPECT OF REOPENING QUICKSILVER MINES in Sulphur Creek district is reported as favorable. Some preliminary work has been done.

Inyo County

CERRO GORDO (Keeler)—Installation of electric power was so far completed by middle of January as to operate compressor. Heavy snows have caused some delay but within short time hoist and all other machinery about mine will be operated by electricity brought in by pole line from Keeler; furnishes 175 hp.

Mariposa County

MOUNTAIN KING (Mariposa)—Net production in three months ended Dec. 31, 1915, was over $60,000. Property is said to be improving with development.

Nevada County

COE (Grass Valley)—Old hoist plant recently destroyed by fire. Prospect of reopening mine, in which case new hoist plant will be built.

Placer County

ORO FINO (Ophir)—Boulder and Bellevue and other mines operated by company will increase production. Company is taking out about $20,000 a month.

Plumas County

SOUTHERN EUREKA (Greenville)—New incorporation with capitalization of $2,000,000, organized under laws of Washington and development and operation of mines in Greenville district. Property contains about 450 acres, including nearly half a mile of Crescent-Indian Valley vein and the Hibernia, McClellan and Southern Eureka mines, formerly operated by late George Standart, of Greenville; also Wardlow group adjoining. Directors are: Hal J. Cole, E. F. Yeager, H. R. Van Dreathen, George D. Needy, M. A. De Huff, all residents of Spokane.

San Bernardino County

MOJAVE TUNGSTEN CO. (San Bernardino)—Company incorporated with capitalization of $1,000,000 to develop and operate 12 tungsten claims in eastern side of county. Nearest railroad station is at Roach, Nev., about 19 mi. east, on San Pedro and Los Angeles R.R. Large amount of development already done and large tonnage of ore exposed. Mine equipped with crusher and concentrator plant. Company composed chiefly of New York men with head office at 165 Broadway.

COLORADO

San Miguel County

TOMBOY (Telluride)—In January mill ran 29 days; crushed 12,000 tons of ore, yielding bullion and concentrate, $87,400; expenses for period, $59,600; profit, $27,800.

Teller County

CRIPPLE CREEK DRAINAGE TUNNEL (Cripple Creek)—Heaviest flow on record, 16,000 gal. per min., is reported now flowing from Roosevelt Tunnel.

IDAHO

Shoshone County

HIGHLAND-SURPRISE (Pine Creek)—Has 150 tons high-grade mill concentrates in bins but is having difficulty delivering them to railway at Beeler.

TUSCUMBIA (Wallace)—Mine and mill have been closed down on account of bad weather and danger from snowslides. Work will be resumed as soon as weather permits.

TAMARACK (Custer)—Has option on controlling interest in Black Bear property, which has been explored to depth of 1,150 ft. and which has large tonnage of developed ore.

LITTLE PITTSBURG (Pine Creek)—New mill, which was built in midwinter in record time of six weeks, started Feb. 2. Company expects to ship carload of concentrates daily. G. S. Hinkle has contract for hauling ore to station at Beeler and is using 42 horses.

SUCCESS (Wallace)—Judge Woods set Feb. 14 as date for Success company to render accounting for ore extracted from ground owned by Alameda. Order is outgrowth of recent litigation in which Alameda alleged extraction of ore to value of $30,000 and asked court to order accounting.

STAR ANTIMONY (Kellogg)—Made its first shipment of 30 tons last week which will average above 50% antimony. Ore was closely sorted and hand jigged. Company is driving a lower tunnel which is expected to greatly enlarge amount of ore available.

CALEDONIA (Wallace)—Although comparatively small property, is entitled to rank as one of richest mines of Cœur d'Alenes as indicated by the following figures, for year 1915: Ore mined, 15,004.83 tons; gross value, $1,246,859.69, average $83 per ton; profit, $760,324, average $51 per ton; gross production per man per day (about), $138; profit per man per day (about), $84.

REX (Wallace)—According to annual report of Manager M. J. Sweeny, old Rex mine has record of production of $750,000, most of which was made at time when zinc in ore was penalized. Efforts are being made to put mine on producing basis after long idleness; diamond drilling has disclosed commercial ore in parallel vein. Company owns 300-ton mill under lease.

OSCEOLA MINING CO. (Wallace)—This recently incorporated company is preparing to install compressor and electric power to develop ground formerly known as War Eagle, on Placer Creek—1½ mi. from Wallace. Wisconsin capitalists back of enterprise. Dennis Reardon, formerly superintendent of Green Hill Cleveland, will have charge of property.

HYPOTHEEK (Kingston)—After drifting on main vein both east and west for more than 200 ft. on 1,100 level and finding nothing but barren quartz, company about a month ago began drifting on stringer encountered in crosscut from shaft about 50 ft. from vein. After drifting west 80 ft. stringer widened to 2 ft. of clean galena. In east drift at 70 ft. it has widened to 3 ft. of quartz with bunches of galena coming in similar to showing that preceded solid ore in west.

MICHIGAN

Copper

SOUTH LAKE (Houghton)—Is building shaft rockhouse. Expected to go into commisison in three or four months.

ISLE ROYALE (Houghton)—Now handling largest rock tonnage in its history. Capacity of Isle Royale three-stamp head has been increased so that it is not unusual now for mill to treat 2,200 tons of ore per day.

WINONA (Winona)—Is preparing for increased production. Plans have been completed for reopening No. 1 King Phillip shaft, shafthouse of which was destroyed by fire several years ago. New building will be of wood and material is already on the way.

HANCOCK (Hancock)—Small shipments of Hancock copper rock through Quincy No. 7 shaft to Quincy mill continue, but several weeks will elapse before Hancock will have sufficient openings to maintain tonnage sufficient to keep one head of Quincy mill in operation. Six levels are now being opened.

Iron

M. A. HANNA (Crystal Falls)—Monongahela property is being opened up through Carpenter. Not enough work done yet to determine what ore lies there.

TOBIN (Crystal Falls)—Workings are now free of water. Mine was unwatered at rate of 9 ft. a day. By next Monday there will be 200 men at work. When the 13th level is opened another 100 will be added.

OHIO (Michigamme)—Pumps were started this week. Will require several weeks to get out water. Over 100 men will be employed when mining starts. At present there is not a mine operating in Michigamme field.

NEWPORT MINING (Ishpeming)—Now requires all applicants for employment to undergo a physical examination. Company considers such course necessary because of the compensation law. There have been several cases in the Lake Superior district where men have applied for compensation, when their injuries or ailments began sometime previous to time that act took effect. Newport company states that the men do not object to taking examination, and there is no doubt but that better class of labor will result. Other companies in the iron region are now considering following example of Newport people and it is not at all unlikely that before many years every man who desires to go into mines will have to submit to an examination.

MINNESOTA

Duluth

GEO. H. CROSBY, of Duluth, has taken a lease on the NE¼ of NE¼, Sec. 18, 46-29, in vicinity of Rowe Mine, Cuyuna Range. Royalty stated to be 32c. per ton.

THE EASTERN MESABI RANGE, so called, will be thoroughly prospected by Eastern capital. Field work is now being carried on. District has always been known to have magnetic iron ores, and interested parties plan erection of an experimental concentrator at Duluth for testing these ores.

Cuyuna Range

CUYUNA IRON AND MANGANESE ORE (Ironton)—A dividend of 3c. per share recently declared, being dividend No. 2, 217,000 shares outstanding. Company holds underlying lease on Mahnomen Pit at Ironton.

DULUTH-BRAINERD (Ironton)—By order entered in district court, obtained by receiver of company, assessment of $1 a share has been levied on stockholders, payable in 30 days. Company formerly held lease on property north of Ironton, but lost same through non-payment of royalties. Mine now known as Fierro mine, being developed in small way by other interests. Company has nearly 300 stockholders, with some individual holdings as high as 8,000 shares.

CROSBY (Nashwauk)—New mill will probably be started about Apr. 15. About 300,000 tons of ore will be put through. Mill was completed just prior to first of year.

TIOGA (Chisholm)—This new property made initial hoist of ore on Feb. 2. Is first property on Mesabi Range to be operated entirely by electricity.

CAVOUR (Kinney)—Filtration plant will be installed at abandoned Cavour mine by Pittsburgh Filter Co., enabling residents of Kinney location to obtain drinking water from mine workings.

MONROE (Chisholm)—Work on new station in shaft is progressing. All timber in station is being replaced with steel and concrete. Many improvements of minor nature being made at property.

WEBB (Hibbing)—Shenango Furnace will install washing plant at this property this spring. Allis-Chalmers has contract for mechanical construction. Will be first washing plant to be installed at an underground mine.

STEVENSON (Hibbing)—Operations are to be resumed immediately. Force of 250 will be employed. Only underground work will be carried on until spring. Pit will be opened at that time. Most of machinery will be driven by electricity. Property is owned by Corrigan, McKinney & Co.

MONTANA

Deer Lodge County

ELK GOLD (Deer Lodge)—At directors' meeting held Feb. 2 it was voted to levy assessment of one mill per share on all outstanding stock. Contract was also let to J. C. Conlin to sink shaft an additional 25 ft. at a rate of $10 per ft. Directors feel much encouraged over company's prospects.

Silver Bow County

BUTTE & LONDON (Butte)—Shaft is now down close to 1,400 level and indications of nearing good vein of ore are increasing.

BARNES-KING (Butte)—Has secured an option on Woodrow Wilson claims known as Parker-Brownlow group, in Rimini district, close to Helena. Property has never been developed and has only 26-ft. prospect hole on it, but company has a year in which to make its investigations and carry on development.

BOSTON & MONTANA (Butte)—Next six weeks promise some important developments in affairs of company. Crosscutting to Idanaha and Park veins is nearing completion and indications of high mineralization are becoming more and more marked. Flow of water has been steadily increasing, indicating presence of vein area ahead. Company has ordered a large amount of new machinery.

BUTTE-BALLAKLAVA (Butte)—Since settlement out of court of legal difficulties with Anaconda, company is again in splendid shape for profitable operations. On basis of sales of its copper at 18c. a pound, earnings for November last were $20,000. With increased price of copper, present earnings should be far in excess of that. Daily shipments of ore amount to 200 tons. New bodies of high-grade ore, recently encountered, promise material increase in output.

ANACONDA (Butte)—By deal consummated Feb. 9 becomes owner of all property of Butte-Alex Scott Copper Co. for consideration of $750,000. Purchase includes Little Annie claim and east 500 ft. of Alex Scott claim. Latter adjoins West Colusa of Anaconda on north. On portion of claim acquired by Anaconda is located plant and shaft of Alex Scott. West part of Alex Scott was owned by Anaconda for some time. Butte-Alex Scott is a Delaware corporation with capital stock of $1,250,000, divided into $10 shares. It was incorporated in February, 1909, and has been producing copper for a number of years. Property is developed by a 2,200-ft. shaft and has recently been provided with complete modern equipment.

DE HORA DREDGE (Butte)—Question of ownership of famous dredge is being thrashed out before Judge McClernan in suit entitled A. B. Melzner against W. E. Ward and others. Some time ago dredge of defunct British Butte company was sold by sheriff and purchased by Shirley H. Jenks, of London, England, through his attorney, English, of Butte. For services rendered English filed claim against Jenks to tune of $7,500. Later A. B. Melzner purchased claim for $1,000, thereby considering himself owner of dredge. Then came W. E. Ward. Jenks' representative and started to dismantle dredge and remove its machinery. Melzner secured an injunction restraining Ward from removing dredge or any of its belongings. This injunction Melzner is asking to be made permanent. Jenks claims that sale was not a bona fide one and that he is still owner of the dredge. Present suit is being heard to decide status of ownership.

NEVADA

Esmeralda County

GOLDFIELD CON. (Goldfield)—Estimated production for January: Total tons mined, 31,000; gross extraction, $209,000; operating expenses, $149,000; net realization, $60,000.

NEVADA METAL EXTRACTION (Goldfield)—Construction a little delayed by recent storms, but buildings now completed and large portion of the equipment in place. Plant will be operating by first of March; capacity of 150 tons per day.

GOLDFIELD CON. (Goldfield)—Final report for December shows 35,610 tons mined and milled with net profit of $53,028. Net costs were $4.48 per ton. Leasers produced 706 tons, gross value $9,274. Development amounted to 2,811 ft. at $5.37 per ft. Preliminary estimate for January shows 31,000 tons mined and milled with a gross recovery of $209,000. Operating costs amounted to $149,000, leaving $60,000 for net realization.

JUMBO EXTENSION (Goldfield)—At directors meeting held Feb. 5 a dividend of 7½c. per share was declared, payable Mar. 31, to stockholders of record Mar. 1. Disbursement amounts to $116,250. Preliminary report for January shows 3,123 tons mined and marketed for a gross return of $81,500. Freight, treatment, and sampling amounted to $28,250, and smelter losses $12,500. Operating expense was $17,500, leaving a net realization of $23,250.

REORGANIZED BOOTH (Goldfield)—At a recent meeting of directors a dividend of 5c. per share was declared payable Mar. 6, to stockholders of record, Feb. 29. Disbursement amounts to $50,000. During 1914 company did 2,239 ft. of development work without exposing any appreciable amount of profitable ore, but received through apex settlements $15,000 cash and 300,000 shares of Jumbo Extension stock, 250,000 shares Kewanas stock, and 750,000 shares Merger stock. Property not being worked at present.

Nye County

TONOPAH ORE PRODUCTION for week ended Feb. 5 was 8,445 tons, valued at $177,270, compared with 8,390 tons for week previous. Producers were: Tonopah Belmont, 3,040 tons; Tonopah Extension, 1,800; Tonopah Mining, 1,625; Jim Butler, 1,000; West End, 549; Halifax, 49; miscellaneous leases, 382 tons.

TONOPAH EXTENSION (Tonopah)—Net profits for the month of December amounted to $57,290. Little is being done at old No. 1 shaft as work of cleaning old stopes and robbing pillars has been practically finished.

Storey County

OPHIR (Virginia)—Central tunnel development carried on in north drift 250 level, old fill of good milling ore exposed. Saved 95 cars of ore from stope and development work. Ophir mill resumed operation on Feb. 3.

SIERRA NEVADA (Virginia)—Raise in old stope 2,400 level shows porphyry and vein matter low assay; 2,500 north drift in vein matter low assay and winze in No. 1 stope in low-grade ore.

UNION CON. (Virginia)—Increased tonnage extracted from 2,400 and 2,500 levels as follows: No. 2 stope, 104 tons at $20 per ton; No. 3 stope, 396 tons, $12.86; No. 4 stope, 44 tons, $16. Started work on 2,700 level reopening connecting drift to Mexican winze. Shaft reopened 20 ft. to the 140-ft. point below 2,000 station.

UTAH

Beaver County

MOSCOW (Milford)—During January four cars of ore were marketed. This ore was largely from 1,100 level of old workings and was taken out through 800 level of new shaft.

CEDAR-TALISMAN (Milford)—This company has shipped its fourth car of zinc ore since Jan. 1. Developments in ore along incline are encouraging. Large body of low-grade zinc ore which carries bunches of 40% zinc is being blocked out.

Juab County

MAY DAY (Eureka)—Two cars of ore are at Summit station awaiting shipment, but have been delayed on account on heavy snowstorms in Tintic district.

CHIEF CONSOLIDATED (Eureka)—Report for 1915 shows 36,412 tons of ore to have been shipped which brought net smelter returns of $309,136. The gross value of the ore was $20.55 per ton, which with deductions for sampling, transportation, etc., of $10.59, left net value of $9.96 per ton. Different classes of ore averaged: 0.1273 oz. gold, 1.09 oz. silver, 13.61% lead, 1.058% copper, 32.97% zinc. Receipts from ore sales and other income, including balance on hand Jan. 1, 1915, of $186,748, amounted to $511,684. Disbursements, including total mining costs of $186,722, and two dividends of $44,027 each, amounted to $301,650. There was balance on hand, Jan. 1, 1916, of $210,034. Since company was organized ore sales have brought $1,771,238.

Piute County

MINERAL PRODUCTS (Marysvale)—Will increase the capacity of potash plant from 25 to 50 tons a day by additional unit, to be erected by Westinghouse Church Kerr & Co. Some of equipment for new unit is on ground. Hauling is at present difficult and teams have replaced motor trucks to some extent.

Salt Lake County

CARDIFF (Salt Lake)—Another vein 4 ft. in thickness has been cut in limestone footwall west of main orebody. This was reached about 200 ft. from tunnel level. Teams have been sent to mine for hauling.

SOUTH HECLA (Alta)—Ore teams are breaking road to mine, and shipments will be started shortly. Development in ore on and above 250 level continues, and winzes are being sunk in ore from 250. One of these is down 40 feet.

UTAH APEX (Bingham)—Report for quarter ended Nov. 30, 1915, shows net earnings of $65,011. Gross earnings were $245,653; expenses $143,108; development, $31,655; bond interest, etc., $5,877. Since last report Parvenu orebody has been cut on 1,300 level, showing ore of same character as that above. Copper orebody mentioned in last report proved valuable. In October management decided to take out this ore by means of leases, and give all of its attention to mining and milling of lead ores. October earnings fell off, owing to increased development cost and change in character of milling ore from lead to copper, also cost of flotation installation. Flotation system was installed and is working satisfactorily. Net proceeds for year 1915 were $235,492, according to statement filed with the board of equalization Feb. 10.

Summit County

SILVER KING CONSOLIDATED (Park City)—Roads from mine have again been opened and shipments of ore resumed. Present deep snow shows advantages of proposed new transportation tunnel starting from near mouth of Thaynes Cañon.

SNAKE CREEK TUNNEL (Park City)—During January progress of 401 ft. was made. First 310 ft. was made in better than record time, when caving ground requiring timbering was encountered. Face is beyond broken ground and good progress is again being made. Face is in 14,122 ft., at this point being about 3,000 ft. vertically from surface. Flow of water at portal is approximately 9,000 gal. a minute.

CANADA

Ontario

NORTHERN ONTARIO LIGHT AND POWER CO. has announced that hereafter power in Porcupine will be sold at a flat rate of $40 a horsepower year based on a 3-min. peak. This is same rate as has been in effect in Cobalt for some time and will be a considerable reduction from rates previously in existence in Porcupine. Company has a surplus of about 3,000 hp. in Cobalt and will build a line into Kirkland Lake about 50 mi. long, to transmit this power for benefit of mines there. Increasing demands for power in Porcupine have necessitated further development of existing powers and it is expected that work now contemplated will call for an expenditure of $1,500,000.

VIPOND (Porcupine)—Orebody recently struck at 400 level carries $14 ore across width of 10 ft.

JUPITER (Porcupine)—Is shipping some ore to McIntyre mill. Property is controlled by McIntyre company.

HAMMELL SYNDICATE (Manitoba)—This syndicate backed by New York capital has let contract to Smith & Durkee, of Sudbury, Ont., at $50,000, for diamond drilling on properties at Athapaposkaw Lake near The Pas. Four diamond drills are on the way.

McINTYRE (Porcupine)—Showed record earnings in January. There was milled total of 8,950 tons; average grade, $7.94; gross value, $71,076; operating costs, $32,500; net profit, $38,400. Mill is being increased to 400 tons a day.

NIPISSING (Cobalt)—In January mined ore of estimated net value $169,802 and shipped bullion from Nipissing and customs ore of an estimated net value of $148,730. High-grade mill treated 81 tons and shipped 251,676 oz. of silver. Low-grade mill treated 5,278 tons.

DOME (Porcupine)—January statement shows that there was milled 31,600 tons of ore from which was recovered $176,990, or an average of $5.58 a ton. This constitutes record production and value. In the crosscut between shafts No. 2 and No. 3 there was encountered an entirely new orebody which showed 27 ft. of $9.60 ore and 58 ft. of $4.30 ore. South crosscut from No. 3 shaft is in $10 ore. Shaft is being timbered to 700-ft. level.

TOUGH-OAKES (Kirkland Lake—With new compressor running will have capacity of 30 drills. For past three months mill has been running entirely on development and dump ore. Mine is in excellent shape and has some very rich ore. If difficulties arising out of appointment of new board of directors are not settled it is possible that mine may be closed down or operated by bank. There is no apparent end to litigation now in progress and pending.

MEXICO

Aguascalientes

THE GOVERNOR OF AGUASCALIENTES is reported to have cancelled various smelting concessions held by American concerns. The decree, designed to increase State and National revenues, states that the concessions, granted by the former "Dictatorial Government," were illegal and in some cases had been secured by bribery. It is understood that the State Department has entered a protest on behalf of American investors.

Sonora

MOCTEZUMA COPPER (Nacozari)—Company plans to sink new shaft and install 2 electric hoists, capable of lifting 10 tons 2,500 ft. Railway scales are being installed at mill to weigh concentrates; new system of conveyor belts is being put in for purpose of loading cars. Third aërial tramway for disposal of tailings recently completed, about 2,900 ft. long. Company is considering advisability of erecting 50- to 100-ton cyaniding plant to treat low-grade ore in Churunibabi and adjoining properties. Moctezuma now employs about 1,500 men; deepest shaft 1,300 ft.

AFRICA

Rhodesia

DECEMBER PRODUCTION is now reported. Gold saved for the full year 1915 was 914,028 oz., or 59,548 oz. more than in 1914. Other production in 1915 was 195,233 oz. silver; 3,509 tons copper; 26 tons lead; 1,976 tons asbestos; 60,581 tons chrome ore; 406,200 tons coal.

AUSTRALIA

MINERS AT BROKEN HILL, N. S. W., went on strike Jan. 10, demanding increased wages and a 44-hr. week instead of 48. Judge Higgins declines to arbitrate unless strikers resume work at full time.

The Market Report

Metal Markets

NEW YORK—Feb. 16

Continued strength was exhibited in all of the metals last week, especially in copper and spelter.

Copper, Tin, Lead and Zinc

Copper—The volume of business transacted by producers during the last week was rather less than in the previous week. Business was chiefly with domestic manufacturers, but France continued to be a persistent buyer. The demand from England was quiet.

A good deal of variety in prices is now exhibited. Certain producers are able to sell only for June and later deliveries, and make a price irrespective of time. If any earlier copper be released to them they give it to their regular customers at the same price. Other producers make a difference according to time of delivery. Thus, on Feb. 14, one of the large producers was selling at 27½c. for April, 27c. for May-June, and 26¾c. for July-August, all of these quotations being on regular terms. About the same prices prevailed on the following days. For small quantities of copper bought and sold for immediate and prompt delivery all sorts of premiums are realized.

Copper Sheets are quoted at 33c. per lb. for hot rolled and 34c. for cold rolled. Copper wire is 27½@28c. per lb., in large lots at mill.

Tin—This market was stronger, but no features of special interest developed.

Receipts of tin at Atlantic ports Feb. 1 to Feb. 15 were 3,542 long tons. Tin reported afloat for those ports on Feb. 15 was 4,893 tons from the Straits and 150 tons from London; 5,043 tons in all.

Lead—A rather large business was done right through the week. In the latter half independent producers found themselves able to realize premiums over the price of the A. S. & R. Co. The St. Louis market advanced to a level that is out of normal proportion to the New York price. The demand for lead from abroad is huge. The matter of freight room continues to play a great part in this business . Dealers who have sold at c.i.f. prices sometimes found them figuring out not very well. On the other hand, producers are able to sell f.o.b. works at fine prices, the buyer assuming all the burdens of getting the metal to Europe and elsewhere. When producers are able to do this, domestic manufacturers are naturally obliged to enter into competition if they must have lead. On Feb. 16 the A. S. & R. Co. withdrew temporarily from the market, reëntering in the afternoon with an advance of price to 6.30c., New York. This followed the consummation of a satisfactorily large business during the previous days.

Spelter—This market again advanced sharply from day to day. A relatively large business was done. In the first half of the week it was chiefly for export; in the second half, chiefly for domestic consumption. There was one very large sale running ahead to October, but the bulk of the business done during the week was for April-May-June delivery. However, there was a considerable tonnage of spelter sold for February and March, although it was relatively small in comparison with what was done for the second quarter. The price for prompt spelter advanced from about 19c. to about 20½c., while the price for April-May-June advanced from about 16½c. to about 18c.

Zinc Sheets are in good demand, but with no change in prices. The current quotation is $24 per 100 lb., f.o.b. Peru, Ill., less 8% discount.

Other Metals

NEW YORK—Feb. 10

Aluminum—The market is more active in demand, and supplies are again rather short. Prices are firmer, current quotations being 56@58c. per lb. for No. 1 ingots, New York delivery.

Nickel—The market is steady with about the usual business doing. Quotations are 45@50c. per lb., New York, for ordinary forms, with 5c. per lb. more asked for electrolytic.

Antimony—The demand continues good, so close to the supply, in fact, that it is hard to keep up deliveries. Prices are strong, Chinese and other ordinary brands being held at 44@44½c. per lb. for spot. Nothing has been done in futures, expected arrivals for the next two or three months being all covered. Cookson's is in very short supply, the small lots available being held at 57@60c. per lb., New York.

Two steamships arrived at New York this week with several hundred tons of antimony, but it is not expected that these imports will come on the general market to any extent.

The Antimony Corporation, a concern with a capital of $1,000,000, was incorporated Feb. 15 at Dover, Del. The charterers are Joseph S. Fay, Sherborn, Mass.; Olof Wenatrom, Brookline, Mass., and Freeman Hinckley, Boston.

DAILY PRICES OF METALS IN NEW YORK

Feb.	Sterling Exchange	Silver, Cts. per Oz.	Copper	Tin	Lead		Zinc
			Electrolytic, Cts. per Lb.	Spot, Cts. per Lb.	New York, Cts. per Lb.	St. Louis, Cts. per Lb.	St. Louis, Cts. per Lb.
10	4.7588	56⅜	26 @26½ 26½	41⅛	6.25	6.15 @6.17½ 6.15	16.50 @19.00 17.00
11	4.7588	56⅜	@27	41½	6.25	@6.17½ 6.15	@19.50 17.25
12	.....	..	....	..	....	@6.20	@19.75
14	4.7600	56⅜	26⅜ @27¼ 26⅜	42	6.25 @6.30 6.25	6.15 @6.20 6.15	17.50 @20.00 17.75
15	4.7600	56½	@27¼ 26⅜	42¼	@6.30	@6.20 6.17½	@20.25 18.00
16	4.7600	56¼	@27¼	42	6.30	@6.22½	@20.50

The quotations herein are our appraisal of the average markets for copper, lead, spelter and tin based on wholesale contracts for the ordinary deliveries of the trade as made by producers and agencies; and represent, to the best of our judgment, the prevailing values of the metals, reduced to basis of New York, cash, except where St. Louis is given as the basing point. St. Louis and New York are normally quoted 0.17c. apart.

The quotations for electrolytic copper are for cakes, ingots and wirebars. Electrolytic copper is commonly sold at prices including delivery to the consumers and is subject to discounts, etc. The price quoted for copper on "regular terms" is the gross price including freight to the buyer's works and is subject to a discount for cash. The difference between the price delivered and the New York cash equivalent is at present about 0.25c. on domestic business. The price of electrolytic cathodes is 0.05 to 0.10c. below that of electrolytic. Quotations for lead represent wholesale transactions in the open market for good ordinary brands. Quotations for spelter are for ordinary Prime Western brands. Only the St. Louis price is herein quoted, St. Louis being the basing market. We quote the New York price at 17c. per 100 lb. above the St. Louis price.

Silver quotations are in cents per troy ounce of fine silver.

Some current freight rates on metals per 100 lb. are: St. Louis-New York 17c.; St. Louis-Chicago, 6.3c.; St. Louis-Pittsburgh, 13.1c.

LONDON

Feb.	Silver	Copper				Tin		Lead		Zinc	
		Standard		Electrolytic							
		Spot	3 Mos.	£ per Ton	Cts. per Lb.	Spot	3 Mos.	£ per Ton	Cts. per Lb.	£ per Ton	Cts. per Lb.
10	27	104½	103	134	28.53	179½	179½	32	6.81	92	19.59
11	27	103½	102⅜	134	28.53	180	179¾	32⅛	6.84	93	19.81
12	26 15/16	.....	.....	.....	.....	.....	.....	.....	.....	....	....
14	26⅞	106	104½	135½	28.85	181	180¾	32⅛	6.84	93	19.81
15	26 13/16	106½	105	136½	29.06	182½	182½	32¼	6.87	99	21.07
16	26 13/16	104½	102	136½	29.06	182	182	32⅛	6.84	100	21.29

The above table gives the closing quotations on London Metal Exchange, All prices are in pounds sterling per ton of 2240 lb., except silver which is in pence per troy ounce of sterling silver, 0.925 fine. Copper quotations are for standard copper, spot and three months, and for electrolytic, price for the latter being subject to 3 per cent. discount. For convenience in comparison of London prices in pounds sterling per 2240 lb., with American prices in cents per pound the following approximate ratios are given, reckoning exchange at 4.80. £ 15 = 3.21c.; £20 = 4.29c.; £30 = 6.43c.; £40 = 8.57c.; £60 = 12.85c. Variations, £1 = 0.21½c.

Quicksilver—The market continues strong, but still a little irregular. Stocks are scarce, arrivals being absorbed as fast as received. New York quotations are $285@300 per flask of 75 lb. for larger orders; $295@300 for smaller lots. San Francisco reports by telegraph $325 per flask, with sales small. Business generally is restricted by the high prices, buyers taking only what is absolutely needed. The London price continues fixed at £16 15s. per flask.

Minor Metals—Current quotations for **Bismuth** are $4 per lb., New York.—**Cadmium** is quoted at 7s. per lb. in London; $1.50 per lb., New York.—**Chromium metal,** 75c. per lb., New York. —**Cobalt metal,** 97% pure, is sold at $1.25@1.50 per lb.—**Magnesium,** pure, has gone to a high price, $6 per lb. being asked.—**Selenium** varies from $2.50@3 per lb., New York, for large lots; $4.50@5 for retail quantities.

IMPORTS AND EXPORTS

Spanish Exports of Minerals 11 months ended Nov. 30 as reported by "Revista Minera" in metric tons:

	Metals		Ores, etc.	
	1914	1915	1914	1915
Iron	28,358	114,580	5,826,100	4,007,032
Copper	16,200	16,260	79,970	29,095
Copper precipitate	8,979	10,187	.....	.....
Lead	138.700	144.341	1 717	832
Zinc	3,105	3,758	66,137	33,489
Quicksilver	1,280	709	.....	.....
Manganese	.....	.....	8,316	8,483
Pyrites	.....	.....	2,565,417	1,954,673
Salt	.....	.....	491,094	462,740

Imports of coal in 1915 were 1,595,028 tons, a decrease of 718,602 tons from 1914; imports of coke 167,795 tons, a decrease of 160,312 tons.

Gold, Silver and Platinum

NEW YORK—Feb. 16

Gold—It is understood that about $5,000,000 gold is to be shipped from New York to Amsterdam, to adjust the high rates on Dutch Exchange, and to provide for the annual tobacco sales.

Gold production in Rhodesia for the full year is now reported. The total was $17,662,102 in 1914, and $18,892,959 in 1915; an increase of $1,230,857 last year.

The gold return for West Africa in December was 37,818 oz. This makes totals for the year ended Dec. 31 of 419,510 oz., or $8,671,271 in 1914, and 412,273 oz., or $8,521,682 in 1915; a decrease of 7,237 oz., or $149,589 last year.

Platinum—The situation remains unchanged. Supplies are restricted and prices continue nominal and very high. It is difficult to fix quotations, as sales depend largely on conditions of each order. Sales are reported at $85 up to $95 per oz. for refined platinum. In one or two cases $100 is reported paid, but that is exceptional.

Our Russian correspondent writes that after reaching a very high point the market has declined slightly, owing to larger offerings by producers. The decline still leaves prices high and an advance is expected. Demand for home use, especially from the acid works, is large, and production is not likely to increase as many miners and small producers are in the army. Quotations for crude metal, 83% platinum, are 16.50 rubles per zolotnik at Ekaterinburg, and 63,000 rubles per pood at Petrograd; equal to $62.04 and $61.74 per oz., respectively. The market is firm at this level.

Palladium—The demand for this metal is on the increase lately and prices are advancing, $55@60 per oz. being quoted.

Silver—The market continues fairly steady. Demand continues still to be for mintage chiefly in England and on the Continent. Stocks at the various silver centers have gradually diminished, and the probability is that current prices are likely to be maintained.

Zinc and Lead Ore Markets

JOPLIN, MO.—Feb. 12

Blende, high price $126.50; base per ton 60% zinc, premium ore, $125; medium grades $120@110; and lower grades down to $105; calamine, per ton, 40% zinc, $70@80; average selling price, all grades of zinc, $116.69 per ton. Lead, high price, $87.20; base per ton, 80% metal content, $84@86; average selling price, all grades of lead, $83.93 per ton.

SHIPMENTS WEEK ENDED FEB. 12

	Blende	Calamine	Lead	Values
Totals this week..	14,482,210	782,720	2,448,280	$976,510
Totals this year..	75,807,070	6,882,620	11,936,850	4,861,200

Blende value, the week, $844,970; 6 weeks, $4,145,700.
Calamine value, the week, $28,800; 6 weeks, $246,470.
Lead value, the week, $102,740; 6 weeks, $469,030.

The ore shipped this week was largely loaded the first three days of the week, a thaw coming on Thursday that has made loading impossible in many localities the latter half of the week. Tonight it has frozen again, and if it continues cold over Sunday active loading of this week's purchases will begin early Monday. The water situation in the north Webb City group is easier, and the additional pumps are beginning to make headway against it. It is not thought the light rain the past two days will seriously affect the underground. Outlying mines depending upon coal fuel cannot haul it and a number of these are idle. This week's shipment relieves the district of all but three lots of reserve ore, one of which is sold.

PLATTEVILLE, WIS.—Feb. 12

The base price paid this week for 60% zinc ore was $117@121 per ton. The base price paid for 80% lead ore was $78 per ton.

SHIPMENTS, WEEK ENDED FEB. 12

	Zinc Ore, Lb.	Lead Ore, Lb.	Sulphur, Ore, Lb.
Week	3,330,000	50,000	834,300
Year	23,582,000	415,000	4,705,300

Shipped during week to separating plants, 5,580,000 lb. zinc ore.

Iron Trade Review

NEW YORK—Feb. 16

New business in finished steel continues to come in. Export orders are large and in some cases urgent as to delivery. Some steel works, it is said, are sold up for the whole of the current year, while others have no room left for the first half of the year and very little for the third quarter. Consumers are getting rather urgent about their requirements for the third and fourth quarters, and are seeking to cover themselves for that period; while others are growing anxious about deliveries for current needs.

Storms and very cold weather have interfered with production and, to a greater extent, with deliveries of material by the railroads. Some mills and furnaces have had trouble in getting coke as fast as they need it, owing to railroad delays and to shortage of cars. Labor in the coke regions is not overabundant.

The pig-iron market is rather quiet again, though two or three heavy orders for basic iron are reported. Not much has been done in foundry iron this week. Some dealers are looking forward to a new buying movement to set in by the end of this month.

The following announcement has been made as to the purchase of the Cambria Steel Co. property:

"The Midvale Steel and Ordnance Co. announces that it has made a contract with Messrs. Stotesbury, Donner and Replogle for the acquisition of so much of the stock of the Cambria Steel Co. at $81 per share as may be deposited with Drexel & Co. by Feb. 19, 1916. This purchase will be financed in the following manner:

"A. The Midvale Steel and Ordnance Co. will issue and sell to the Guarantee Trust Co. and Lee, Higginson & Co. $50,000,000 of its 20-year 5% collateral trust sinking fund bonds, convertible into the company's stock at any time at $100 per share.

"B. The company will issue and offer to its stockholders at $60 per share its $25,000,000 of treasury stock, which offer has already been underwritten by a syndicate."

The authorized capital stock of the Midvale Steel and Ordnance Co. is $100,000,000, of which $75,000,000 has been issued.

It is understood that negotiations are now pending for the sale of Pennsylvania Steel Co. stock to a syndicate which is reported to be affiliated with the Bethlehem Steel Co. Nothing definite has been given out so far.

The United States Steel Corporation reports its unfilled orders on Jan. 31 at 7,922,767 tons of material, which is an increase of 116,547 tons over Dec. 31, and a gain of 3,574,196 tons over Jan. 31, 1915. The total is almost the largest ever reported.

PITTSBURGH—Feb. 15

Steel prices show as much of an advancing tendency as ever. Yesterday wire products were advanced $2 a ton, making nails $2.30, and constituting the second advance this year in wire products, while today standard steel pipe underwent its third advance since Jan. 1, steel pipe going up one point, to 75% off list on sizes ¾- to 3-in., while line pipe was correspondingly advanced and oil country goods advanced irregularly from $3 to $4 a ton. Billets are quotable $2 to $3 a ton higher. The average advance in all finished steel products since this movement began is about $17 per net ton.

Plates have doubled in price, going from 1.05c. for prompt or early delivery, to 2.10c. for far-forward delivery and 2.50c. to 3c. for early deliveries.

The unfilled tonnage of the Steel Corporation at the close of January, announced on Feb. 10 at 7,922,767 tons, represented the unexpectedly small gain of 116,547 tons during January. The interesting computation has been made that with shipments at 15,000,000 tons a year, a conservatively low estimate, such a tonnage would run out on Aug. 12, as an average date. The large mills are reputed to be practically sold up for almost the entire year, and the explanation given of the apparent divergence, when hitherto the Steel Corporation's unfilled obligations as reported have been considered in excess of the tonnage buyers were certain to take, is that instead of accepting definite contracts at fixed prices the mills have merely given assurance to regular customers that they would be taken care of during the second half of the year, at such prices as might be ruling.

Specifications are heavy on all steel contracts and the mills are in most cases shipping at practically their maximum rate. Weather, car shortages and scant labor supplies at individual points have proved inconveniences but have not operated to curtail production materially. The labor supply promises to be a very serious matter later, when outdoor operations will make a bid for men. It is reported that some of the mills are quietly paying a premium on some of their common labor. Strictly new buying of steel products is light, but the market is certainly presenting all the appearances of underlying strength.

Pig Iron—Pig Iron is a shade softer, due to confinued light demand. Bessemer and basic are quotable at 50c. and 25c. respectively below former figures, while foundry iron, which at one time sold freely at $19, Valley, with $18.50 as a low price, is now going freely at $18.50, even for second half. The fundamental conditions appear strong, with furnaces decreasing their stocks and the outlook that consumption, rather than production, will increase. We quote: Bessemer, $20.50; basic, $17.75@18; forge and malleable, $18@18.50; foundry, $18.50, f.o.b. Valley furnaces, 85c. higher delivered Pittsburgh.

Steel—Sales of soft billets are becoming somewhat more common. Several lots of odds and ends in small billets have been sold at $38@$40, for immediate shipment. There are bids of $35 for bessemer billets for early delivery, regular specifications. We quote besemer billets and sheet bars at $35 and $36 and openhearth at $38, representing advances of $2 and $3 respectively over previous quotations, but there is no regular market, each transaction being a law to itself. Rods are now offered at $50, for deliveries beginning say four months hence, an advance over our previous quotations of $5 per ton.

There is a strong demand for forging billets for export, and high prices are being paid for this steel.

FERROALLOYS

Ferrosilicon of high grade is in demand still. The nominal quotation for 80% alloy is $85 per ton, Pittsburgh, but up to $95 is reported paid for lots for early delivery.

Spiegeleisen is firm and higher. Sales of 20% alloy are made at $40 per ton, Pittsburgh.

Ferromanganese—The shortage of prompt alloy has apparently become acute with some consumers, as bids of $225 for spot lots of 50 tons have been made without finding sellers, and $250 has been quoted. Receipts on contracts have been light thus far this year. The contract price on English remains at $125, Baltimore, but deliveries would be very uncertain.

FOREIGN IRON

The German Iron and Steel Union reports the production of pig iron in Germany in December at 1,029,144 metric tons, which is 174,948 tons more than in December, 1914, and 582,106 tons less than in December, 1913. For the year ended Dec. 31, 1915, the total make of pig was 11,790,077 tons.

The report of the German Steel Works Union for the fiscal year ended June 30, 1915, recently made public, shows total shipments of 3,393,537 metric tons, against 6,124,310 tons in the preceding fiscal year, or 55.41% of the latter. The domestic trade absorbed 80% of the 1914-15 total, the foreign sales being necessarily restricted because of the war. The average daily shipments were 11,109 tons as against 20,098 tons in the fiscal year of 1914 and 21,104 tons in 1913. The daily rate fell from 17,423 tons in July, 1914, to 3,653 in August on the breaking out of the war, but increased to 12,305 tons in June, 1915. The shipments for the fiscal year 1915 were 739,451 tons of semi-finished steel against 1,639,829 tons in the year previous; 1,759 115 tons of railroad material against 2,748,728 tons and 894,971 tons of shapes, against 1,735,753 tons.

IRON ORE

Shipments by rail of Lake Superior iron ore from Lake Erie docks to furnaces were 887,426 tons, being 638,303 tons more than in January, 1915. The stock remaining on docks Feb. 1 was 7,071,275 tons, being 731,531 tons less than on Feb. 1 last year.

Furnace contracts for mill cinder and puddling scale have been closed by eastern furnaces at about $3.50@3.75 per ton for mill cinder and $5@5.50 for puddling and heating scale, both delivered. This shows advances of about $1.50 per ton over last year.

Witherbee, Sherman & Co. have let a contract for a large ore dock on Lake Champlain at Port Henry, N. Y. The dock will be of steel and concrete construction, 1,000 ft. long and 250 ft. wide, and it will have a storage capacity of 350,000 tons. The cars will dump direct to the dock and the ore will be loaded into barges by a modern electrically-operated ore bridge equipped with clam-shell bucket. The enlargement of the Champlain Canal will permit the use of large barges from Port Henry to tidewater.

The Thomas Iron Co. has contracted for the entire output of the iron mine of the Hoff Mining, Realty and Improvement Co., Wharton, N. J., for the next three years. The stock of ore on hand at the mine, amounting to about 5,000 tons, has already been shipped to the furnace at Hokendauqua, Penn. Operations at the mine have just been resumed after two years of idleness.

OTHER ORES

Antimony Ore is in some demand and sales have been made of moderate lots at $2.50 per unit—**Molybdenite**, 85 to 90% MoS_2, is quoted at $1.40@1.45 per unit, with a moderate demand.—**Tungsten Ore** is in very strong demand. The high prices have apparently failed to bring out new supplies. As high as $65 per unit has been paid for February and March delivery.

COKE

Connellsville—Car supply was rather poor all last week. This week, Monday brought a good supply but Tuesday saw a distinct shortage, owing to cold weather. Some of the furnaces are probably short of coke, but seem to be averse to inquiring for spot coke fearing that some operators might sell to the detriment of deliveries on contracts. Three sales ase reported in the past week at above $3.50, but in general the market is quotable at $3.25@$3.50, but in general the market is quotable at $3.25@3.50 for prompt furnace and $3.75@4.25 for prompt foundry, per net ton at ovens. There is no interest in contracts.

Coke production in the Connellsville region is reported by the "Courier" at 433,182 short tons; shipments, 420,686 tons. The shipments were cut down a little by bad weather. Shipments of the Greensburg and Upper Connellsville districts were 43,279 tons.

Anthracite Shipments in January were 5,884,350 long tons. As compared with January, 1915, this is an increase of 1,050,-751 tons.

Chemicals

NEW YORK—Feb. 16

Business has been steady and the tone of the general market has been firm, with good sales in most lines.

Arsenic—Consuming demand appears to be larger and inquiries are more frequent. Quotations are $5.25 per 100 lb. for carloads and over, and $5.50 per 100 lb. for smaller lots.

Copper Sulphate—There is a fair inquiry, both for domestic delivery and for export. Quotations are unchanged at about $22 per 100 lb. for carload lots and $22.25 per 100 lb. for smaller orders.

Pyrites—Receipts at Baltimore for the week included 9,850 tons of pyrites from Huelva, Spain.

Nitrate of Soda—More chartering of nitrate tonnage from Chile is reported, but at high rates. Business here is reported good and prices are firm at $3.60 per 100 lb. for spot. Futures are offered at $3.55 per 100 lb. Production in Chile in December is reported at 5,526,910 quintals, a large increase over last year. Shipments from the West Coast for the year ended Dec. 31 are reported as follows, in tons:

	1914	1915	Changes
Europe	1,210,700	1,622,100	I. 411,400
United States	518,850	811,750	I. 292,850
Total	1,729,550	2,433,850	I. 704,250

The total shipments in 1913 were 2,593, 800 tons; in 1912 they were 2,345,600 tons.

Sulphuric Acid—Supplies are scarce, the market being generally sold up for some time ahead. Quotations for 60° acid are $25 per ton at works for spot and $22 for futures, buyers to supply cars.

Mining Companies—United States

Name of Company and Situation		Shares Issued	Par	Dividends Total	Latest	Amt.
Acacia, g.	Colo.	1,438,989	$ 1	$ 122,004	Jan '11	$0.01
Adams, s.l.c.	Colo.	80,000	10	778,000	Dec. '09	0.04
Ahmeek, c.	Mich.	50,000	25	3,300,000	Jan. '16	2.50
Alaska Mexican, g.	Alas.	180,000	5	3,507,381	Nov. '15	0.10
Alaska Treadwell, g.	Alas.	200,000	25	15,535,000	Nov. '15	0.50
Alaska United, g.	Alas.	180,200	5	1,991,210	Nov. '15	0.30
Am. Zinc, Lead & Sm.	U. S.	171,200	25	1,108,820	Jan. '14	0.50
Anaconda, c.	Mont.	2,331,250	50	99,573,125	Nov. '15	1.00
Argonaut, g.	Calif.	200,000	5	1,700,000	Dec. '15	0.10
Arizona Copper, pf.	Ariz.	1,426,120	1.20	2,129,063	Nov. '15	
Arizona Copper, com.	Ariz.	1,519,896	1.20	18,461,338	July '15	0.24
Bagdad-Chase, g., pf.	Calif.	184,819	5	202,394	Jan. '09	0.10
Baltic, c.	Mich.	100,000	25	7,950,000	Dec. '13	2.00
Bingham N. H., c.	Utah	228,690	5	454,302	Oct. '15	0.20
Bonanza Dev., g.	Colo.	300,000	1	1,425,000	Oct. '11	0.20
Brunswick, g.	Calif.	395,287	1	179,598	Sept. '15	0.06
Bunker Hill Con., g.	Calif.	200,000	1	875,000	Jan. '16	0.02½
Bunker Hill & Sul., l.s.	Ida.	327,000	10	16,854,750	Jan. '16	0.25
Butte-Alex Scott, c.	Mont.	79,311	10	221,354	Jan. '16	0.15
Butte-Ballaklava, c.	Mont.	250,000	10	125,000	Aug. '10	0.50
Butte & Superior, z.	Mont.	272,019	10	4,509,909	Dec. '15	8.25
Caledonia, l.s.c.	Ida.	2,605,000	1	754,200	Jan. '16	0.02
Calumet & Arizona, c.	Ariz.	617,412	10	23,148,225	Dec. '15	1.25
Calumet & Hecla, c.	Mich.	100,000	25	129,250,000	Dec. '15	15.00
Camp Bird, g.s.	Colo.	1,100,051	5	10,806,551	Jan. '16	0.24
Centen'l-Eur., l.s.g.c.	Utah	100,000	5	4,050,000	Apr. '14	1.50
Center Creek, l.z.	Mo.	100,000	10	550,000	Oct. '15	0.15
Champion, c.	Mich.	100,000	25	11,600,000	Jan. '16	3.00
Chief Consolidated, s.g.l.	Utah	871,384	1	350,460	Nov. '15	0.05
Chino, c.	New Mex.	869,980	5	6,697,995	Dec. '15	1.00
Cliff, g.	Utah	300,000	1	90,000	Jan. '13	0.10
Cliff, g.	Alas.	100,000	1	210,000	Oct. '13	0.01
Colo. Gold Dredging	Colo.	100,000	10	675,000	Sept. '14	1.00
Colorado, l.s.g.	Utah	1,000,000	0.20	2,570,000	Dec. '12	0.03
Columbus Con., g.s.	Utah	285,540	5	226,832	Oct. '07	0.20
Commercial Gold	Ore.	1,750,000	1	43,750	Dec. '10	0.00½
Con. Mercur, g.	Utah	1,000,000	1	3,445,313	July '13	0.03
Continental, z.l.	Mo.	22,000	25	551,000	Dec. '15	10.00
Copper Range Con., c.	Mich.	393,739	100	13,986,746	Oct. '13	0.75
Daly Judge, s.l.	Utah	300,000	1	1,155,000	Dec. '15	0.35
Daly West, s.l.	Utah	180,000	20	6,606,000	Jan. '13	0.15
Doctor Jackpot, g.	Colo.	3,000,000	0.10	84,814	Mar. '10	0.00½
Doe Run, l.	Mo.	65,783	100	3,550,969	Dec. '13	0.76
Eagle & Blue Bell, g.s.l.	Utah	893,146	1	446,573	Aug. '15	0.10
Elkton Con., g.	Colo.	2,500,000	1	3,579,460	May '15	0.02
El Paso, g.	Colo.	490,000	5	1,707,545	Feb. '14	0.10
Ernestine, g.s.	N.M.	300,000	5	150,000	July '15	0.10
Fed. M. & S., com.	Idaho	60,000	100	2,708,750	Jan. '09	1.50
Fed. M. & S., pf.	Idaho	120,000	100	9,466,392	Dec. '15	1.00
Florence, g.	Nev.	1,050,000	1	840,000	Apr. '11	0.10
Frances-Mohawk, g.	Nev.	912,000	1	546,000	Jan. '08	0.05
Free Coinage, g.	Colo.	10,000	100	180,000	Dec. '09	1.00
Fremont Con., g.	Calif.	200,000	2.50	258,000	Oct. '14	0.02
Frontier, z.	Wis.	1,250	100	146,202	Nov. '13	2.00
Gemini-Key'ne, l.g.s.	Utah	5,000	100	2,305,000	Dec. '14	10.00
Gold Chain, g.	Utah	1,000,000	1	130,000	May '13	0.03
Gold Coin of Victor	Colo.	1,000,000	1	1,350,000	Feb. '09	0.02
Gold Dollar Con.	Colo.	2,500,000	0.10	100,000	Dec. '12	0.00½
Gold King Con., g.	Colo.	1,000,000	1	1,417,319	Nov. '15	0.01
Golden Cycle, g.	Colo.	1,500,000	1	4,200,000	Jan. '16	0.02
Golden Star, g.	Ariz.	400,000	5	140,000	Mar. '10	0.05
Goldfield Con., g.	Nev.	3,559,148	10	28,999,832	Oct. '15	0.10
Grand Central, g.	Utah	500,000	1	1,633,250	Dec. '15	0.02½
Granite, g.	Colo.	1,650,000	1	286,500	Dec. '12	0.01
Hazel, g.	Cal.	900,000	1	971,000	Dec. '13	0.01
Hecla, l.s.	Idaho	1,000,000	0.25	3,855,000	Jan. '16	0.10
Hercules, l.s.	Idaho	1,000,000	1	5,725,000	June '15	
Homestake, g.	S. D.	251,160	100	39,005,162	Jan. '16	0.65
Horn Silver, l.s.z.	Utah	400,000	25	5,642,000	Sept. '07	0.05
Iowa, g.s.l.	Colo.	1,666,667	1	270,167	Dec. '15	0.00½
Iowa-Tiger, g.s.	Colo.	3,000	1	25,179	Dec. '15	1.00
Iron Blossom, s.l.g.	Utah	1,000,000	0.10	2,550,000	Jan. '16	0.03
Iron Silver, s.l.g.	Colo.	500,000	20	4,950,000	Dec. '14	0.10
Jamison, g.	Cal.	390,000	10	386,100	Dec. '15	0.01
Jerry Johnson, g.	Colo.	2,500,000	0.10	187,500	Nov. '14	0.01
Kendall, g.	Mont.	500,000	5	1,505,000	July '14	0.06
Kennedy, g.	Cal.	100,000	100	1,831,001	Apr. '10	0.03
King of Arizona, g.	Ariz.	200,000	1	396,000	Aug. '09	0.12
Klar Piquette, z.l.	Wis.	20,000	1	259,000	Apr. '13	0.50
Knob Hill, g.	Wash.	1,000,000	1	70,000	Oct. '13	0.00½
Liberty Bell, g.	Colo.	133,552	5	1,752,795	Sept. '15	
Little Bell, l.s.	Utah	300,000	1	75,000	Mar. '11	0.05
Little Florence, g.	Nev.	1,000,000	1	430,000	Jan. '08	0.03
Mammoth, g.s.c.	Utah	400,000	2.50	2,320,000	Dec. '15	0.05
Mary McKinney, g.	Colo.	1,309,252	1	1,169,308	July '14	0.02
May Day, g.s.l.	Utah	800,000	0.25	244,000	Nov. '15	0.03
Mexican, g.s.	Nev.	201,600	2.50	161,910	June '14	0.75
Miami, c.	Ariz.	747,112	5	6,399,878	Nov. '15	1.00
Modoc, g.s.	Colo.	500,000	1	275,000	Dec. '11	0.01
Mohawk, c.	Mich.	100,000	25	3,575,000	Feb. '15	2.00
Monarch-Mad'a, g.s.l.	Colo.	1,000,000	1	40,000	May '11	0.01
Montana-Tonop., s.g.	Nev.	921,865	1	488,588	Dec. '12	0.10
Mountain, c.	Cal.	250,000	25	4,216,250	May '08	0.44
National, g.	Nev.	750,000	1	570,000	May '11	0.10
Nevada Con., c.	Nev.	1,999,457	5	19,976,159	Dec. '15	1.00
New Century, z.l.	Mo.	330,000	1	237,600	Oct. '09	0.01
New Idria, q.	Cal.	100,000	5	1,830,000	Dec. '15	0.50
North Butte, c.	Mont.	430,000	15	12,492,000	Jan. '16	0.40
North Star, g.	Cal.	250,000	10	4,787,040	Dec. '15	0.20
Old Domin'n, M. & Sm.	Ariz.	162,000	25	6,237,000	Dec. '15	2.00
Ophir, s.g.	Nev.	201,600	3	2,068,360	Jan. '12	0.10
Opohongo, g.s.l.	Utah	898,978	0.25	80,907	Jan. '13	0.02
Oroville Dredging	Cal.	686,498	5	1,770,838	Sept. '15	0.12
Osceola, c.	Mich.	96,150	25	15,189,250	Jan. '15	3.00
Parrot, c.	Mont.	229,850	10	7,871,839	July '15	1.63
Pearl Con., g.	Wash.	1,909,711	0.05	181,422	Dec. '10	0.02
Pharmacist, g.	Colo.	1,500,000	1	87,500	Feb. '10	0.00½
Pioneer, g.	Alas.	5,000,000	1	2,041,526	Oct. '11	0.03
Pittsburgh-Idaho, l.	Ida.	809,407	1	217,083	Apr. '13	0.04
Pittsburgh Silver Peak, g	Nev.	2,790,000	1	771,200	July '14	0.02
Portland, g.	Colo.	3,000,000	1	10,260,080	Jan. '16	0.03
Quilp	Wash.	1,500,000	1	67,500	Feb. '12	0.01

Mining Companies—United States—(*Continued*)

Name of Company and Situation		Shares Issued	Par	Dividends Total	Latest	Amt.
Quincy, c.	Mich.	110,000	$ 25	$21,777,500	Dec. '15	$2.00
Ray, c.	Ariz.	1,485,333	10	5,092,033	Dec. '15	0.50
Republic, g.	Wash.	1,000,000	1	170,000	Nov. '12	0.01½
Rochester, l.s.	Mo.	4,900	100	190,846	July '12	0.50
Round Mountain, g.	Nev.	1,266,591	1	363,365	Aug. '13	0.04
Seven Troughs Coal., g.	Nev.	1,500,000	1	180,380	Dec. '15	0.02½
St. Joseph, l.	Mo.	1,474,798	10	10,197,413	Dec. '15	0.25
Shannon, c.	Ariz.	300,000	10	750,000	Jan. '13	0.50
Shattuck Arizona, c.	Ariz.	350,000	10	3,325,000	Jan. '16	1.00
Silver King Coal., l.s.	Utah	1,250,000	5	3,284,885	Jan. '16	0.15
Silver King Con., l.s.	Utah	637,582	1	814,857	Dec. '15	0.10
Sioux Con., s.l.g.	Utah	745,389	1	872,097	July '11	0.04
Skidoo, g.	Cal.	1,000,000	5	365,000	Oct. '14	0.01
Snowstorm, c.g.	Ida.	1,500,000	1	1,192,103	Oct. '13	0.02
South Eureka, g.	Calif.	299,981	1	638,878	Jan. '16	0.07
Standard Con., g.s.	Cal.	178,394	10	5,274,407	Nov. '13	0.25
Stewart, s.l.	Ida.	1,238,362	1	2,012,314	Dec. '15	0.05
Stratton's Ind., g.	Colo.	1,000,000	0.60	618,625	Jan. '16	0.04
Success, z.	Ida.	1,500,000	1	1,095,000	Jan. '16	0.03
Superior & Pitts., c.	Ariz.	1,499,792	10	10,318,569	Dec. '15	0.38
Tamarack, c.	Mich.	60,000	25	9,420,000	July '07	4.00
Tennessee, c.	Tenn.	200,000	25	5,056,250	Jan. '16	0.75
Tomboy, g.s.	Colo.	310,000	4.85	3,709,395	June '15	0.24
Tom Reed, g.	Ariz.	909,555	1	2,443,757	Apr. '15	0.06
Tonopah Belm't, s.g.	Nev.	1,500,013	1	8,018,026	Jan. '16	0.12½
Tonopah Ext., g.s.	Nev.	943,433	1	1,037,772	Jan. '16	0.07½
Tonopah of Nev., s.g.	Nev.	1,000,000	1	13,150,000	Jan. '16	0.15
Tri-Mountain, c.	Mich.	100,000	25	1,450,000	Dec. '13	2.00
Tuolumne, c.	Mont.	800,000	1	520,000	May '13	0.10
Uncle Sam, g.s.l.	Utah	500,000	1	495,000	Sept. '11	0.05
United Cop. Min., c.	Wash.	1,000,000	1	40,000	Nov. '12	0.01
United (Crip. Ck.) g.	Colo.	4,000,100	1	440,435	Jan. '10	0.04
United Globe, c.	Ariz.	23,000	100	2,472,500	June '15	6.00
United Verde, c.	Ariz.	300,000	100	37,297,000	Feb. '16	0.75
Utah, s.l.	Utah	100,000	10	281,860	Dec. '10	0.02
Utah, c.	Utah	1,624,490	10	32,711,896	Dec. '15	1.50
Utah Con., c.	Utah	300,000	5	9,000,000	Sept. '15	0.50
Valley View, g.	Colo.	1,000,000	1	240,000	Dec. '10	0.04
Victoria, g.s.l.	Utah	250,000	1	207,500	Mar. '10	0.04
Vindicator Con., g.	Colo	1,500,000	1	3,397,500	Jan. '16	0.03
Wasp No. 2, g.	S. D.	500,000	1	549,466	Jan. '16	0.05
Wellington Mines, g.	Colo.	10,000,000	1	650,000	Nov. '15	0.02
Wolverine, c.	Mich.	60,000	25	8,520,000	Oct. '15	4.00
Yak, s.l.	Colo.	1,000,000	1	1,937,685	Sept. '15	0.03
Yankee Con., g.s.	Utah	1,000,000	1	167,500	Jan. '13	0.01
Yellow Aster, g.	Cal.	100,000	10	1,172,789	Dec. '15	0.02
Yellow Pine, l.z.s.	Nev.	1,000,000	1	893,008	Dec. '15	0.15
Yukon Gold, g.	Alas.	3,500,000	5	7,672,000	Dec. '15	0.07½

Iron, Industrial and Holding Companies

Amalgamated, c.	Mont.	1,538,879	5 100	103,444,983	Aug. '15	$3.77
Am. Sm. & Ref., com.	U. S.	500,000	100	29,333,333	Dec. '15	1.00
Am. Sm. & Ref., pf.	U. S.	500,000	100	53,958,333	Dec. '15	1.75
Am. Smelters, pf. A.	U. S.	170,000	100	10,782,250	Jan. '16	1.50
Am. Smelters, pf. B.	U. S.	300,000	100	15,875,000	Jan. '16	1.25
Greene Cananea	U. S.	486,209	100	4,857,855	Jan. '16	1.00
Guggenheim Expl.	U. S.	833,732	25	24,157,059	Jan. '16	1.00
Inter'l Nickel, com.	U. S.	380,315	100	23,408,834	Nov. '15	5.00
Inter'l Nickel, pfd.	U. S.	89,126	100	8,739,358	Nov. '15	1.50
National Lead, com.	N. Y.	206,554	100	9,035,544	Dec. '15	0.75
National Lead, pf.	N. Y.	243,676	100	30,972,404	Dec. '15	1.75
Old Dominion, c.	Ariz.	293,245	25	7,573,806	Dec. '15	2.00
Phelps, Dodge & Co.	U. S.	450,000	100	45,659,304	Dec. '15	5.50
U. S. Steel Corp., com.	U. S.	5,083,025	100	222,360,438	Dec. '14	0.50
U. S. Steel Corp., pf.	U. S.	3,602,811	100	389,503,012	Nov. '15	1.75
U. S. S., R. & M., com.	U.S.-Mex.	351,114	50	6,625,524	Jan. '16	0.75
U. S. S., R. & M., pf.	U.S.-Mex.	486,348	50	16,795,255	Jan. '16	0.87½

Canadian, Mexican and Central American Companies

Ajuchitlan, g.s.	Mex.	50,000	$ 5	$ 212,500	Oct. '12	$0.25
Amparo, g.s.	Mex.	2,000,000	1	1,640,884	Nov. '15	0.03
B. C. Copper	B. C.	591,709	5	615,198	Jan. '13	0.15
Beaver Con., s.	Ont.	1,996,490	1	589,857	Oct. '15	0.03
Buffalo, s.	Ont.	1,000,000	1	2,757,000	July '14	0.03
Canadian Goldfields, g.	B. C.	600,000	0.10	290,000	July '14	0.001½
Chontalpan, g.s.l.z.	Mex.	7,000	25	59,500	May '14	0.75
Cobalt Townsite, s.	Ont.	45,000	1	1,042,259	May '14	0.10
Coniagas, s.	Ont.	800,000	5	7,720,000	Aug. '15	0.30
Con. M. & S. Co. of Can	B. C.	58,052	100	2,324,128	Jan. '16	2.50
Crown Reserve, s.	Ont.	1,768,814	1	6,067,032	July '15	0.02
Crow's Nest Pass C. Co.	B. C.	248,506	25	2,182,864	Mar. '11	0.25
Dos Estrellas, g.s.	Mex.	300,000	0.50	10,335,000	Dec. '13	1.50
El Oro, g.s.	Mex.	1,147,500	4.85	8,947,260	July '13	0.24
Esperanza, s.g.	Mex.	455,000	4.85	12,013,882	July '15	0.24
Granby, s.l.c.	B.C.	149,985	100	5,996,931	Nov. '15	1.50
Greene Con., c.	Mex.	1,000,000	10	10,044,400	Jan. '16	0.50
Guanajuato D., pf., s.	Mex.	10,000	1000	214,356	Jan. '10	3.00
Hedley Gold	B. C.	120,000	10	1,824,000	Dec. '15	1.00
Hollinger, g.	Ont.	600,000	5	4,290,000	Jan. '16	0.20
Kerr Lake, s.	Ont.	600,000	5	6,120,000	Dec. '15	0.25
La Rose Con., s.	Ont.	1,498,627	5	5,462,053	Jan. '16	0.05
Le Roi No. 2, g.	B. C.	120,000	24.30	1,530,900	Dec. '15	0.24
Lucky Tiger Com., g.	Mex.	715,337	10	3,263,391	Dec. '15	0.09
McK.-Dar. Sav. s.	Ont.	2,247,692	1	4,675,195	Jan. '16	0.03
Mines Co. of An. (new)	Mex.	1,700,000	10	1,215,000	July '13	0.12½
N. Y. & Hond. Ros., g.	C. A.	200,000	10	3,890,000	Jan. '16	0.50
Nipissing, s.	Ont.	1,200,000	5	13,830,000	Jan. '16	0.25
Peñoles, s.l.g.	Mex.	80,000	25	6,361,688	June '13	1.25
Pinguico, pf., s.	Mex.	20,000	100	840,000	Oct. '13	3.00
Right of Way Mns, s.	Ont.	1,685,500	1	543,759	Nov. '14	0.02
Rio Plata, s.	Mex.	374,518	5	345,745	Feb. '13	0.05
San Rafael, g.s.	Mex.	2,400	25	1,442,380	Jan. '14	0.50
San Toy, g.s.	Mex.	5,750,000	1	530,000	July '13	0.01
Sorpresa, g.s.	Mex.	19,200	20	3,979,240	Jan. '11	34.00
Stand'd Silver-Lead.	B. C.	2,000,000	1	1,850,000	Jan. '16	0.02½
Temiskaming, s.	Ont.	2,500,000	1	1,459,155	Dec. '15	0.06
Tem. & Hud. Bay, s.	Ont.	7,761	1	1,940,250	Nov. '14	3.00
Trethewey, s.	Ont.	1,000,000	1	1,061,998	July '14	0.05
Wettlaufer-Lorrain, s.	Ont.	1,416,590	1	637,465	Oct. '13	0.05

Assessments

Company	Delinq.	Sale	Amt.
Alta-Germanic, Utah	Feb. 8	Feb. 28	$0.005
Alta Tunnel, Utah	Feb. 15	Mar. 4	0.01
Basalt, Nev	Mar. 8	Apr. 6	0.003
Belmont, Ida	Feb. 15	Mar. 11	0.003
Boston Development	Feb. 17	Mar. 8	0.05
Cash Boy, Nev	Feb. 16	Mar. 20	0.01
Columbie Ex., Utah	Feb. 23	Mar. 14	0.025
Deer Creek C. & G., Utah	Feb. 5	Feb. 26	0.005
Duluth-Brainerd, Minn	.....	.....	1.00
Elk Gold, Mont	.....	.....	0.001
Emerald, Utah	Feb. 15	Mar. 11	0.00¼
Emerald, Utah	Mar. 15	Apr. 11	0.00¼
Empire M. & D., Ida., (post.)	.....	Mar. 10	0.005
Exchequer G. & S., Nev	Feb. 16	Mar. 8	0.03
Four Timbers, Ida	Feb. 24	Mar. 24	0.002
Great Copper King, Utah	Feb. 14	Mar. 11	0.001
Imperial, Ida	Feb. 19	Mar. 20	0.003
Independence, Utah	Jan. 20	Feb. 14	0.001
Index, Ida	Feb. 6	Mar. 6	0.0025
Jacket-Crown Pt.-Belc., Nev	Feb. 18	Mar. 10	0.06
Laclede, Ida	Feb. 4	Feb. 28	0.003
Lucky Deposit, Utah	Feb. 11	Mar. 13	0.005
Massasoit, Utah	Jan. 13	Feb. 23	0.015
Monarch Pitts., Nev	Feb. 18	Mar. 20	0.01
Nabob, Ida	Jan. 17	Feb. 14	0.005
Nevada-Douglas, Nev	Feb. 10	Mar. 10	0.10
Park Gold, Utah	Apr. 1	Apr. 20	0.001
Queen Bess, Utah	Feb. 20	Mar. 20	0.005
Revenue Cons., Utah	Feb. 5	Mar. 3	0.01
Rexall, Utah	Feb. 2	Feb. 21	0.01
Rio Grande Grubstake, Utah	Dec. 25	Feb. 29	0.006
Rob Roy, Ida	Feb. 5	Mar. 5	0.002
Santaquin King, Utah	Feb. 8	Mar. 8	0.00125
Scorpion, Nev	Feb. 21	Mar. 14	0.01
Silver Moon, Ida	Feb. 26	Mar. 22	0.005
Silver Mountain, Ida	Feb. 17	Mar. 17	0.002
Slavonian, Ida	Feb. 1	Feb. 29	0.001
Snowshoe, Ida	Feb. 15	Mar. 15	0.005
Summit Ex., Utah	Mar. 15	May 1	0.01
Tar Baby, Utah	Dec. 31	Feb. 28	0.005
Tarbox, Ida., (post.)	.....	Feb. 26	0.003
Tyler M. & M., Ida	Jan. 28	Feb. 28	0.001
Utah-Oregon, Utah	Jan. 5	Feb. 10	0.0005
Utah-United, Utah	Mar. 10	Mar. 30	0.01
Uvada, Nev	Feb. 21	Mar. 20	0.02
Western Star, Ida	Jan. 10	Jan. 31	0.001
West Toledo, Utah	Mar. 6	.....	0.01

Stock Quotations

COLO. SPRINGS Feb. 15		SALT LAKE Feb. 15	
Name of Comp.	Bid.	Name of Comp.	Bid.
Acacia	‡.05¾	Beck Tunnel	.17
Cripple Cr'k Con.	‡.009	Black Jack	.13
Dante	‡.04	Colorado Mining	.18½
Doctor Jack Pot	.10¾	Crown Point	.04½
Elkton Con	.34	Daly-Judge	8.30
El Paso	.85	Emma Cop	.54
Findlay	.04	Gold Chain	.12½
Gold Dollar	‡.03	Grand Central	.63
Gold Sovereign	.04½	Iron Blossom	1.52½
Golden Cycle	2.11½	Lower Mammoth	.06¾
Isabella	.22½	May Day	.21
Jack Pot	‡.06½	Opohongo	.02
Jerry Johnson	‡.06½	Prince Con	1.10
Lexington	‡.004	Seven Troughs	.01½
Mary McKinney	.45½	Silver King Coal'n	3.22½
Pharmacist	‡.01¾	Silver King Con	2.32½
Portland	1.75	Sioux Con	.09¾
Raven B. H.	.02½	Uncle Sam	.11
Vindicator	2.30	Yankee	.28

SAN FRANCISCO Feb. 15			
Alta	.06	Belmont	4.35
Andes	.05	Jim Butler	.95
Best & Belcher	.02	Lone Star	.03
Caledonia	.32	MacNamara	.03
Challenge Con	‡.05	Midway	.15
Chollar	‡.02	Mont.-Tonopah	.25
Confidence	.20	North Star	.14
Con. Virginia	.07	Rescue Eula	.07
Gould & Curry	.01	West End Con	.76
Hale & Norcross	.02	Atlanta	.19
Jacket-Cr. Pt.	.04	Blue Bell	.02
Julia	.01	Booth	.38
Mexican	.18	C.O.D. Con	.03
Occidental	.75	Comb. Frac	.07
Ophir	.16	D'field Daisy	.03
Overman	.05	Jumbo Extension	1.10
Savage	‡.04	Pitts.-Silver Peak	.09
Seg Belcher	.03	Round Mountain	.59
Sierra Nevada	.20	Sandstorm Kendall	.06
Union Con	.45	Silver Pick	.03
Utah Con	.02	Central Eureka	.10

TORONTO Feb. 15			
Bailey	‡.04¾	Dome Exten	.30
Chambers Ferland	.24½	Dome Lake	.27
Coniagas	4.37½	Foley O'Brien	.55
La Rose	.65	Hollinger	29.50
Peterson Lake	.26	Imperial	‡.04
Right of Way	‡.07	Jupiter	.23½
Seneca Superior	.66	McIntyre	1.02
T. & Hudson Bay	25.00	Porcu. Crown	.80
Temiskaming	.67½	Preston E. D.	‡.05
Trethewey	.16	Vipond	‡.75
Wettlaufer-Lor	.08	West Dome	.15

LONDON Feb. 2			
Alaska Treadwell	£7 2s 6d	Mexico Mines	£3 17s 6d
Burma Corp	1 13 1½	Nechi, pfd	0 14 0
Cam & Motor	0 13 0	Oroville	0 14 6
Camp Bird	0 7 6	Santa Gert'dis	0 10 0
El Oro	0 8 9	Tomboy	1 2 0
Esperanza	0 10 6	Tough Oakes	0 12 6

N. Y. EXCH. Feb. 15		BOSTON EXCH Feb. 15	
Name of Comp.	Clg.	Name of Comp.	Clg.
Alaska Gold M	23½	Adventure	2
Alaska Juneau	9	Ahmeek	402½
Am.Sm.&Ref.,com	102	Algomah	1½
Am. Sm. & Ref., pf.	112	Allouez	72
Am. Sm. Sec., pf. A	93½	Ariz. Com., ctfs	9⅛
Am. Sm. Sec., pf. B	86½	Bonanza	.35
Am. Zinc	76½	Butte Alex. Scott	9½
Anaconda	89⅜	Butte-Balaklava	4½
Batopilas Min	2½	Calumet & Ariz	73⅛
Bethlehem Steel	469½	Calumet & Hecla	575
Bethlehem Steel, pf.	133	Centennial	17
Butte & Superior	88	Copper Range	65⅛
Chile Cop	23⅞	Daly West	2½
Chino	58⅛	East Butte	14⅛
Colo. Fuel & Iron	46½	Franklin	10
Crucible Steel	82⅛	Granby	96½
Dome Mines	29⅛	Hancock	16½
Federal M. & S.	27	Hedley	‡26
Federal M. & S., pf.	54½	Helvetia	.40
Great Nor., ore., ctf.	46½	Indiana	5
Greene Cananea	47½	Island Cr'k, com	45½
Guggen. Exp	21¼	Island Cr'k, pfd	89½
Homestake	130	Isle Royale	28½
Inspiration Con	46¼	Keweenaw	2⅞
International Nickel	52⅛	Lake	18
Lackawanna Steel	78	La Salle	4⅛
Miami Copper	37½	Mason Valley	3
Nat'l Lead, com	70⅛	Mass	12½
National Lead, pf	113	Mayflower	4
Nev. Consol	16½	Michigan	1⅛
Ontario Min	7⅞	Mohawk	93
Quicksilver	5	New Arcadian	9½
Quicksilver, pf	7	New Idria	19½
Ray Con	25½	North Butte	29½
Republic I&S, com	53⅜	North Lake	1⅛
Republic I&S, pf	110	Ojibway	1½
Sloss-Sheffield	59	Old Colony	3½
Sloss-Sheffield, pf	96	Old Dominion	70
Tennessee Copper	59	Osceola	93
Utah Copper	84⅜	Quincy	94½
U. S. Steel, com	83⅜	St. Mary's M. L.	67
U. S. Steel, pf	117⅛	Santa Fe	3⅛
Va. Iron C. & C	55	Shannon	11½
		Shattuck-Ariz	38½
N. Y. CURB Feb. 15		So. Lake	7½
Alta Con	.22½	So. Utah	.35
Beaver Con	.39	Superior	22
Big Four	.04	Superior & Bost	3⅛
Buffalo Mines	‡1	Tamarack	52½
Butte & N. Y.	3½	Trinity	10
Butte C. & Z	8½	Tuolumne	.18
Can. Cop. Corpn	1⅛	U. S. Smelting	62½
Cashboy	.03	U. S. Smelt'g, pf	50½
Cerro de Pasco	41½	Utah Apex	4½
Con. Ariz. Sm	1½	Utah Con	15½
Con. Coppermines	1⅜	Victoria	3½
Con. Nev.-Utah	‡⅜	Winona	4½
Dia. Black B	.02	Wolverine	66½
First Nat. Cop	6½	Wyandot	2½
Florence	.50		
Goldfield Con	.91	BOSTON CURB Feb. 15	
Goldfield Merger	.17	Bingham Mines	8
Hecla Min	3½	Boston Ely	.50
Howe Sound	7½	Butte & Lon'n Dev	.47
Kennecott Cop	54⅛	Calaveras	3⅜
Kerr Lake	4.35	Calumet-Corbin	.05
Magma	17½	Chief Con	1⅜
Majestic	1½	Cortez	.65
McKinley-Dar-Sa	.48	Crown Reserve	.35
Mines of Am	3	Davis-Daly	1⅜
Mother Lode	.21½	Eagle & Blue Bell	1 5/16
Nevada Hills	.19	Houghton Copper	2½
New Utah Bingham	4½	Iron Cap Cop., pf	7
Nipissing Mines	7⅛	Mexican Metals	.40
Oro	.04½	Nat. Zinc & Lead	2½
Ray Hercules	3½	Nevada-Douglas	.85
Rochester Mines	.60	New Baltic	3½
St. Joseph Lead	16	New Cornelia	12½
Stand'd Oil of N.J.	520	Ohio Copper	.20
Standard S. L	1⅛	Oneco	.80
Stewart	.50	Raven Copper	.18
Success	.86	Rex Cons	.32
Tonopah	6½	Rilla	1⅜
Tonopah Ex	4 1/16	Smokey Dev	‡.30
Tonopah Merger	‡.62	United Verde Ext	12½
Tribullion	‡ 7/32	Utah Metal	9⅛
White Knob, pf	‡1 1/16		
Yukon Gold	2⅛	‡Last Quotations.	

Monthly Average Prices of Metals

SILVER

Month	New York			London		
	1914	1915	1916	1914	1915	1916
January	56.572	48.855	56.775	26.553	22.731	26.953
February	57.506	48.477	.....	26.573	22.753	.....
March	58.067	50.241	.....	26.788	23.708	.....
April	58.519	50.250	.....	26.958	23.709	.....
May	58.175	49.915	.....	26.704	23.570	.....
June	56.471	49.034	.....	25.948	23.267	.....
July	54.678	47.519	.....	25.219	22.597	.....
August	54.344	47.163	.....	25.979	22.780	.....
September	53.290	48.680	.....	24.260	23.591	.....
October	50.654	49.385	.....	23.199	23.925	.....
November	49.082	51.714	.....	22.703	25.094	.....
December	49.375	54.971	.....	22.900	26.373	.....
Year	54.811	49.604	.....	27.314	23.675	.....

New York quotations cents per ounce troy, fine silver; London, pence per ounce, sterling silver, 0.925 fine.

COPPER

Month	New York Electrolytic		London Standard		London Electrolytic	
	1915	1916	1915	1916	1915	1916
January	13.641	24.008	60.756	88.083	65.719	116.17
February	14.394	.....	63.494	.....	*	.....
March	14.787	.....	66.152	.....	*	.....
April	16.811	.....	75.096	.....	*	.....
May	18.506	.....	77.600	.....	*	.....
June	19.477	.....	82.574	.....	95.333	.....
July	18.796	.....	76.011	.....	91.409	.....
August	16.941	.....	68.673	.....	82.333	.....
September	17.592	.....	68.915	.....	85.250	.....
October	17.686	.....	72.601	.....	88.000	.....
November	18.627	.....	77.744	.....	93.273	.....
December	20.133	.....	80.773	.....	100.43	.....
Year	17.275	.....	72.532	.....	.....	.....

TIN

Month	New York		London	
	1915	1916	1915	1916
January	34.260	41.825	156.550	175.548
February	37.415	.....	176.925	.....
March	48.426	.....	180.141	.....
April	47.884	.....	166.225	.....
May	38.790	.....	162.675	.....
June	40.288	.....	167.636	.....
July	37.423	.....	167.080	.....
August	34.389	.....	151.440	.....
September	33.125	.....	152.625	.....
October	33.080	.....	151.554	.....
November	39.224	.....	167.670	.....
December	38.779	.....	167.000	.....
Av. year	38.500	.....	163.960	.....

LEAD

Month	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
January	3.729	5.921	3.548	5.826	18.606	31.167
February	3.827	.....	3.718	.....	19.122	.....
March	4.053	.....	3.997	.....	21.883	.....
April	4.221	.....	4.142	.....	21.094	.....
May	4.274	.....	4.182	.....	20.347	.....
June	5.932	.....	5.836	.....	25.170	.....
July	5.659	.....	5.531	.....	24.611	.....
August	4.656	.....	4.520	.....	21.946	.....
September	4.610	.....	4.490	.....	23.151	.....
October	4.600	.....	4.499	.....	23.994	.....
November	5.155	.....	5.078	.....	26.278	.....
December	5.355	.....	5.266	.....	28.807	.....
Year	4.628	.....	4.587	.....	22.917	.....

SPELTER

Month	New York		St. Louis		London	
	1915	1916	1915	1916	1915	1916
Jan	6.386	16.915	6.211	16.745	30.844	89.810
Feb	8.436	.....	8.255	.....	39.819	.....
Mar	8.541	.....	8.360	.....	44.141	.....
April	10.012	.....	9.837	.....	49.888	.....
May	14.781	.....	14.610	.....	68.100	.....
June	21.208	.....	21.038	.....	100.614	.....
July	19.026	.....	18.856	.....	97.250	.....
Aug	12.781	.....	12.611	.....	67.786	.....
Sept	13.440	.....	13.270	.....	67.841	.....
Oct	12.800	.....	12.596	.....	66.536	.....
Nov	15.962	.....	15.792	.....	88.409	.....
Dec	15.391	.....	15.221	.....	89.400	.....
Year	13.230	.....	13.054	.....	67.553	.....

New York and St. Louis quotations, cents per pound, London, pounds sterling per long ton. * Not reported. ‡ London Exchange closed.

PIG IRON IN PITTSBURGH

Month	Bessemer		Basic		No. 2 Foundry	
	1915	1916	1915	1916	1915	1916
January	$14.59	$21.60	$13.45	$18.78	$13.90	$19.70
February	14.55	.....	13.45	.....	13.90	.....
March	14.55	.....	13.45	.....	13.95	.....
April	14.55	.....	13.45	.....	13.95	.....
May	14.64	.....	13.60	.....	13.83	.....
June	14.70	.....	13.67	.....	13.77	.....
July	14.94	.....	13.91	.....	13.68	.....
August	16.01	.....	15.31	.....	14.75	.....
September	16.86	.....	15.95	.....	15.70	.....
October	16.95	.....	15.96	.....	15.80	.....
November	18.26	.....	17.30	.....	17.20	.....
December	19.95	.....	18.95	.....	18.95	.....
Year	$14.89	.....	$13.76	.....	$13.89	.....